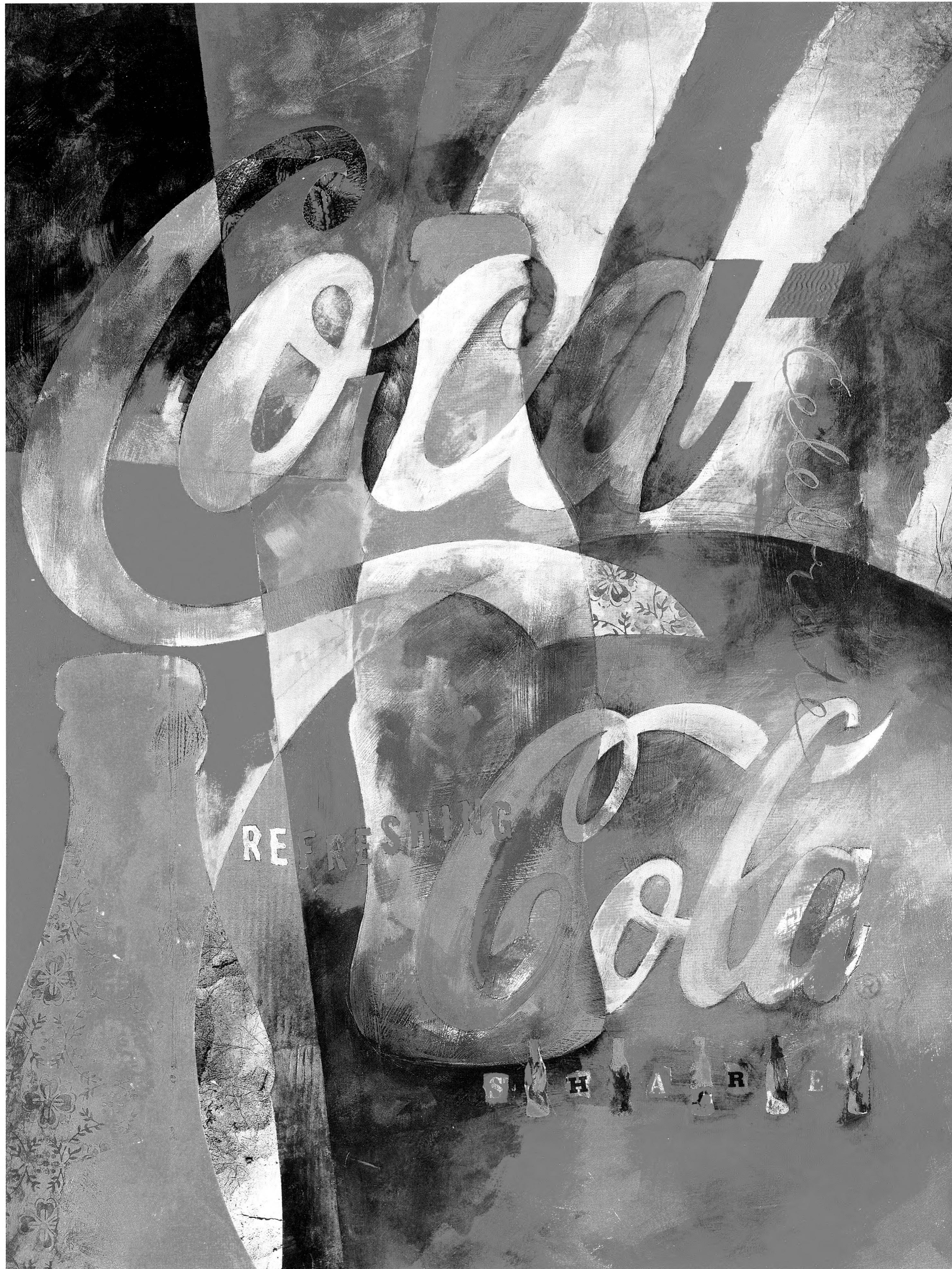
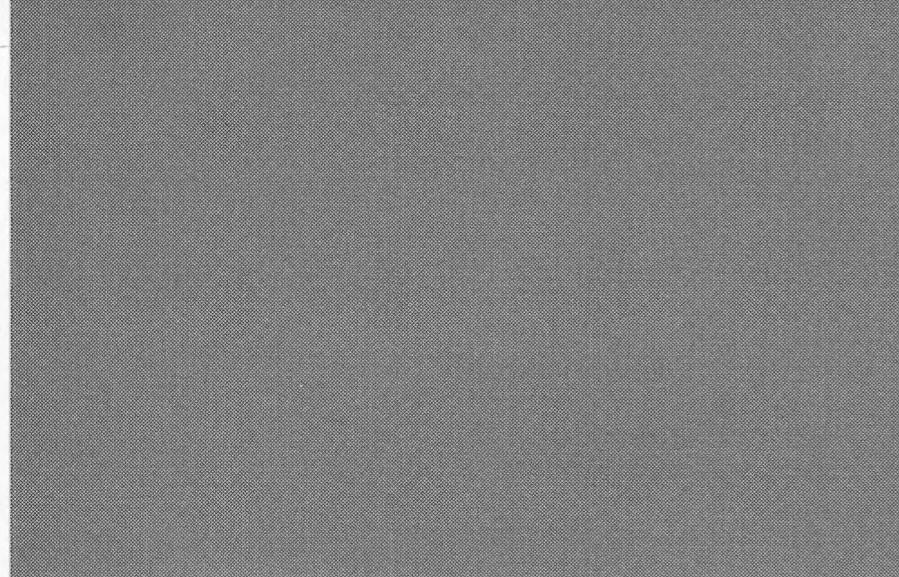


NOVEMBER/DECEMBER 2006

Zoogoer

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Asia's Elusive Acrobat

BY HOWARD YOUTH

Scientists at the Smithsonian's National Zoo delve into the secrets of the clouded leopard, one of Asia's agile cats.

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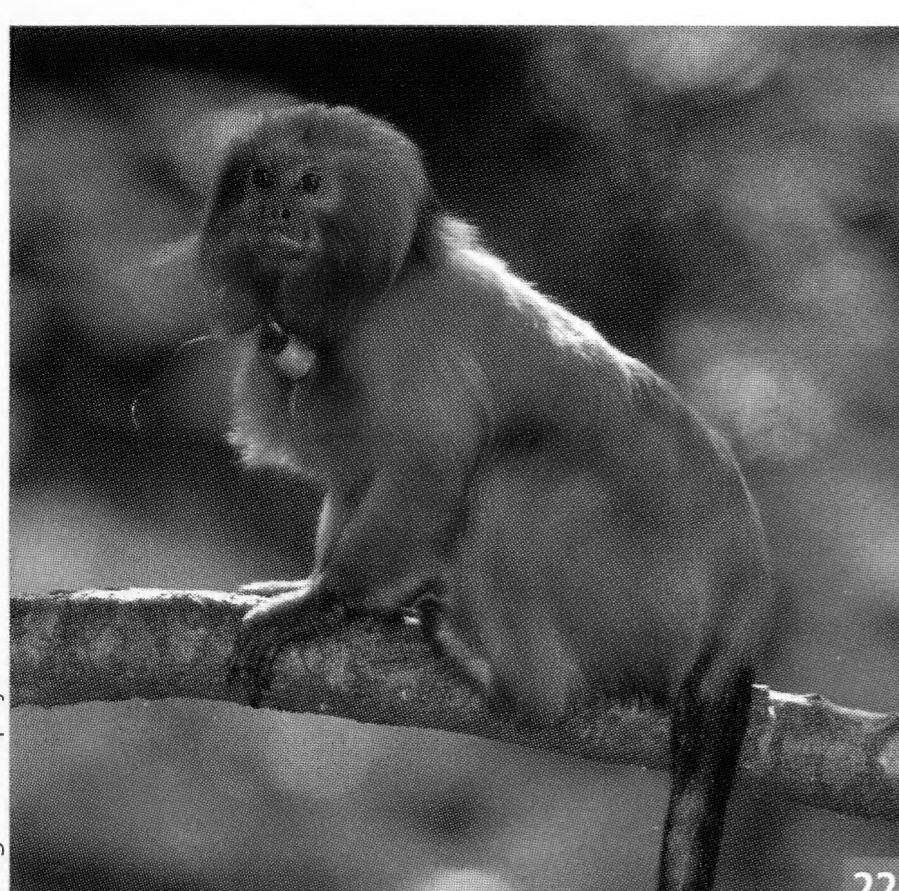
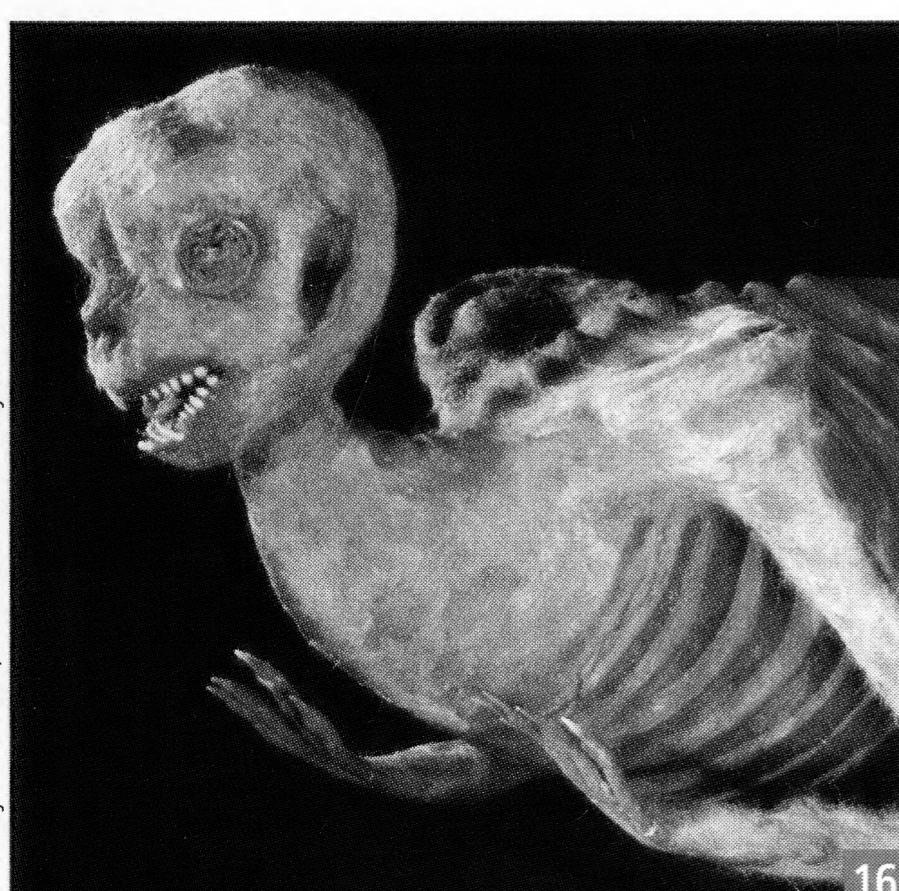
Fake fossils of imaginary beasts reveal to us the science of the past, and help us improve science for the future.

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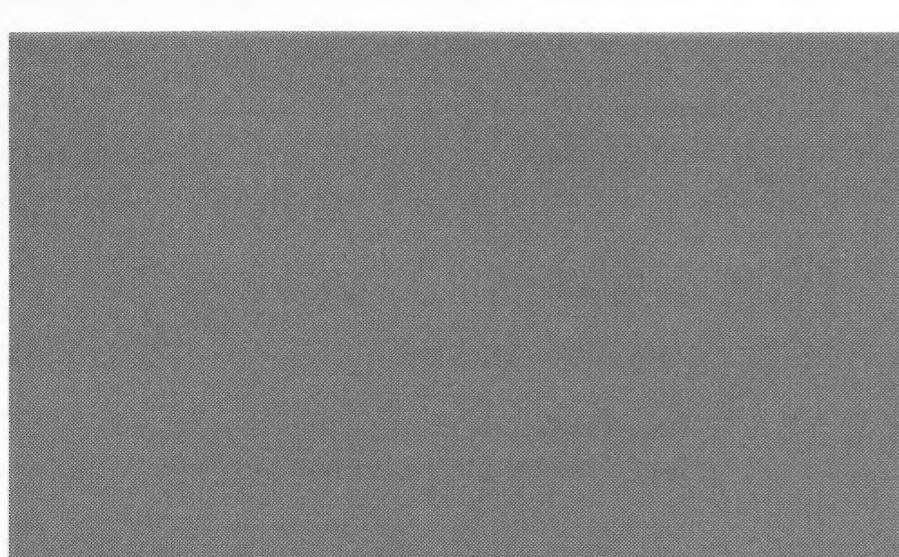
Visit the meerkat pups at the Small Mammal House. You're invited to Kandula's fifth birthday party. Ring in the season at Jingle in the Jungle, FONZ's holiday event for Young Professionals.

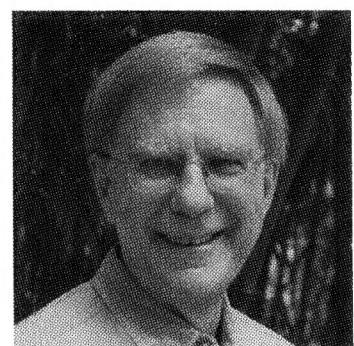
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FONZForum

Science and Survival

In the past few months, I've been learning about the depth and breadth of the conservation and science programs at the Smithsonian's National Zoo, and of FONZ's important role in helping to support those programs. I've been deeply inspired by what I have seen.

I have a longstanding interest in science. I began my career at the National Institutes of Health. At the Department of the Interior, I worked closely with staff at the U.S. Fish & Wildlife Service and the U.S. Geological Survey (USGS) to develop science programs in support of their missions to manage our nation's natural resources. In particular, I was actively involved in creating the Biological Resources Division within the USGS to bring both physical and biological sciences to bear on natural-resource management problems. In short, I believe that good science is essential to sound decision-making and fundamental to building sustainable results.

For many years, Zoo scientists have been instrumental in developing the relatively new sciences of zoo and conservation biology. Going back as far as the mid-1970s, Zoo staff have led the zoo community in making science central to the mission of zoos. And many of the current leaders in the zoo community trained here as interns, residents, and fellows, the vast majority of them supported by FONZ.

In this issue of *ZooGoer*, you will read about our highly acclaimed Golden Lion Tamarin (GLT) Conservation Program. It represents what the Zoo does best. It began in the late 1970s with scientific studies that led to a successful zoo breeding program; a reintroduction program, coupled with education, field studies, and collaboration with Brazilian conservationists; and continued population monitoring to ensure that the significant gains, from fewer than 100 GLTs to 1,600 today, are not lost. As this example shows, saving a species takes long-term, science-based commitment, and FONZ has helped support the GLT program since its inception.

The magnificent scimitar-horned oryx you see when you visit the Zoo represent a species that has slipped into extinction in its native African habitat at the edge of the Sahara. Fortunately, thanks to the foresight of zoo biologists, scimitar-horned oryx survive and thrive in zoos. In fact, the National Zoo began breeding this species as early as 1967! Today, one of North America's largest herds of this species lives at the Zoo's Conservation and Research Center (CRC), and Zoo staff have become world leaders in studying—and championing—the scimitar-horned oryx and other critically endangered Saharan species, such as the dama gazelle. This winter, a male from CRC will be among ten oryx to be reintroduced in Tunisia. Zoo staff are also planning to ramp up their efforts to breed dama gazelles at CRC, with the goal of building a herd of 30 individuals that may be candidates for reintroduction.

Of course, there must be safe places for these animals to go, so Zoo staff are helping to create an 80,000-square-kilometer (about 31,000-square-mile) protected area in Chad and Niger where both scimitar-horned oryx and dama gazelles can be reintroduced, and other desert species protected.

In the next few weeks, you will receive in the mail an appeal for your support for this important Zoo program to conserve and recover Saharan wildlife. Our goal is to raise \$300,000 to improve and expand facilities to care for, study, and breed scimitar-horned oryx and dama gazelles at CRC and to help our scientists create the protected area. I urge you to consider a generous contribution.

FONZ members helped Zoo scientists save the golden lion tamarin and other endangered species, including the black-footed ferret, from extinction. Now you can help them save Saharan wildlife. Thank you for your continued support, and I wish you and your family happy holidays.

Sincerely,

Bob Lamb

Executive Director, Friends of the National Zoo



is a nonprofit organization dedicated to supporting the conservation, education, and research efforts of the Smithsonian's National Zoo. Formed in 1958, FONZ was one of the first conservation organizations in the nation's capital. Friends of the National Zoo is dedicated to supporting the National Zoo in a joint mission to study, celebrate, and protect the diversity of animals and their habitats.

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Smithsonian National Zoological Park is located at 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From October 29, 2006, to March 10, 2007, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m. From March 11, 2007, to November 4, 2007, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m.

Membership in FONZ offers many benefits: programs, publications, discounts on shopping and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537, call 202.633.3034, or go to www.fonz.org.

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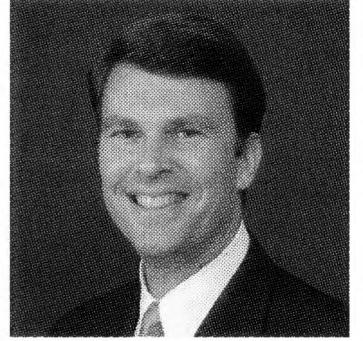
An audio version of *ZooGoer* is available on our website, for members who cannot read standard print due to disability. For more information, please visit www.fonz.org/zoogoer.htm.

On the cover: A free-ranging golden lion tamarin (*Leontopithecus rosalia*) lounges outdoors in the Smithsonian National Zoo's Beaver Valley. Photo by Jessie Cohen/NZP.



The Smithsonian's National Zoo is accredited by the Association of Zoos and Aquariums.

Letter from the Zoo Director



Reflections on My First Year

As I celebrate my first anniversary as Director of the Smithsonian's National Zoo, I'd like to share with you a few things I've learned in the past year. First, I discovered something about the nature of animals. Before coming to the Zoo, I perceived animals as species in which like individuals shared genes and the same appearance, behaviors, and other traits. It didn't take long for the animals here to disabuse me of this idea, as each asserted its individuality.

I'm not sure why this didn't occur to me before—I certainly have witnessed individuality in cats and dogs of the same breeds—but somehow I imagined the world of wild animals as different, simpler even. It is not.

Life is wonderfully complicated. The bands on a cheetah's tail and the pattern of stripes on a zebra or tiger proclaim the animal's uniqueness, much as our fingerprints do. But so does each animal's approach to life—its "personality." Maharani, one of our female tiger cubs, is fearless and friendly; her sister, Melati, is shy and suspicious. Our nine cheetah cubs, most of which now live at other zoos, are as different from one another as any group of children, and their moods, like our own, vary daily with the weather and other factors we can't discern.

Early in my tenure, someone asked me what my favorite animal was. Diplomatically, I said, "All of them, but I'm partial to newborns." I would now add, "and our older animals," which I have come to more deeply respect and appreciate. Although they may not move as fast as their younger counterparts, they seem to have more knowing awareness, are often more creative, and may exhibit what can only be described as a sense of humor. I am humbled when I stand next to our 58-year-old Asian elephant, Ambika, and watch her eyes sparkle after playing a prank or meeting a new person.

I've also learned that managing a zoo, much like living in an extended family, is defined by the circle of life. I regularly share in the joy of arrivals and the pain of departures, sometimes within hours of each other, creating an emotional roller coaster. But my north star is to provide the highest-quality care to every animal entrusted to us. Such care often allows animals to live far longer than they ever would in the wild. We have pioneered geriatric medicine for old individuals suffering from age-related conditions like Parkinson's disease, arthritis, and toothlessness. This has enabled Maureen, our 29-year-old California sea lion, to live nearly twice as long as she might have in the wild and still rule Beaver Valley like a queen.

The hardest decisions I've made concerned when to let an animal go because its quality of life was compromised, not by the normal aches and pains of illness or old age, but by suffering that we could not relieve. These decisions were complicated by the large area of uncertainty in which we must operate because diagnostic tests taken for granted in human medicine often do not exist for animals.

Jafari, a two-year-old giraffe, was diagnosed with an invasive cranial tumor in my first week on the job. I watched in awe as a team of more than a dozen professionals, including Kurt Newman, the chief of surgery at Children's National Medical Center in Washington, D.C., worked feverishly to remove the tumor within the 58 minutes allowed for by the anesthesia. We cheered when Jafari awoke from the anesthesia and stood up. Our spirits were further raised as he ate and sparred with his friend Randall over the course of the next week. But then, head veterinarian Suzan Murray reported that Jafari was only able to turn his head to the right, for one of two possible reasons: Post-operative swelling had compressed a cranial nerve, or the cancerous tumor was more invasive than we hoped. Taking an x-ray was not an option, so Murray tried to treat the swelling. But getting close enough to do this proved too dangerous. When Jafari's condition worsened, we tearfully euthanized him. Pathology results revealed that the left half of Jafari's brain had been under siege by an invasive tumor. Euthanizing him was the right decision, but we could have just as easily been wrong. Like many people who make life-and-death decisions, I pray for the wisdom and humility to make the best decision possible with the imperfect knowledge available.

Finally, I now know at least one thing with absolute certainty. The people who work at the National Zoo—each and every one of them—are among the most talented, passionate, caring, and hardworking people I've met anywhere. (And I have been blessed to work with some very special people, including the dedicated staff of the National Park Service and the U.S. Secret Service, for example, so my standards are very high.)

Together, we have set our goal to become the finest zoo in the world by 2016. We will do that by continuing to provide the highest-quality animal care, conducting world-class conservation science, offering outstanding educational experiences, and being a leader in sustainability. With our talented Zoo and FONZ staff, devoted FONZ Board of Directors and members, and community support, I am confident we will achieve this goal and contribute to ensuring a bright future for our planet and all its inhabitants.

Sincerely,

John Berry

Director, Smithsonian's National Zoological Park

Notes & News



Ann Battorf/NZP

Just a few days after they were born in August, these two meerkat pups and a third littermate emerged from a tunnel in their exhibit to join their mob at the Small Mammal House.

Animal News

The first surviving litter of **meerkat pups** (*Suricata suricatta*) born at the Smithsonian's National Zoo in three decades is now on exhibit at the Small Mammal House. Born in August, the three pups were discovered by keepers who heard squeaking noises coming from one of the meerkat tunnels. In September, a single pup was born into the "mob," as a group of meerkats is called. Meerkats' eyes and ears are closed at birth, but they open when the pups are about ten days old. Pups are typically weaned from their mothers when they are between seven and nine weeks old.

At the Bird House, a new flock of **blue-naped mousebirds** (*Urocolius macrourus*) is sharing an indoor enclosure with **lilac-breasted rollers** (*Coracias caudata*). Blue-naped mousebirds have tan feathers, crested heads, and distinctive blue patches on the backs of their necks. They inhabit dry, wooded habitats in their native Africa, and eat fruits, buds, leaves, and flowers.

The Zoo will celebrate a landmark birthday near the

end of November, when **Asian elephant** (*Elephas maximus*) Kandula turns five. Kandula was conceived through an artificial insemination procedure that National Zoo scientists pioneered for Asian elephants. Since his birth, Kandula has gained more than 3,500 pounds, has grown at least 41 inches taller, and is becoming increasingly independent from his mother, Shanthi. Two **western lowland gorillas** (*Gorilla gorilla gorilla*) also have birthdays in November: Kojo will be five years old on November 5, and his brother, Kwame, will be seven on November 20.

The Zoo bid adieu to three of its year-old female **cheetahs** (*Acinonyx jubatus*) in September. Based on recommendations from the Association of Zoos and Aquariums' Species Survival Plan for cheetahs, the females went to Disney's Animal Kingdom in Florida. There are now five cheetahs at the Cheetah Conservation Station: the females' two male siblings, their mother Zazi and father Ume, and female Tumai.

Jessie Cohen/NZP
A blue-naped mousebird new to the Bird House.

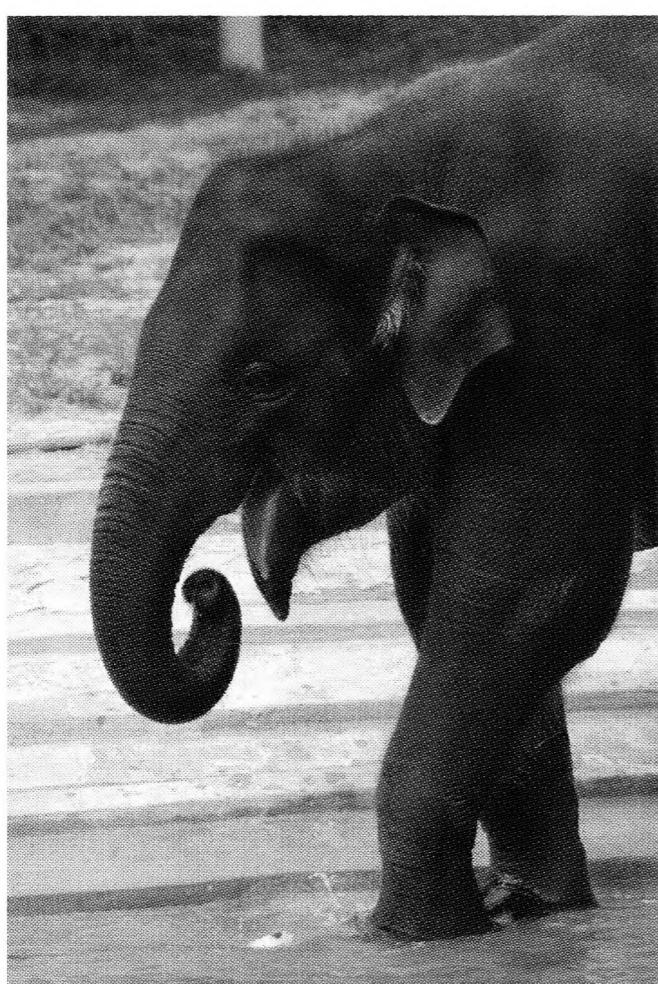
Events and Holiday Happenings

For a complete list of upcoming FONZ events and celebrations, visit www.fonz.org/events.htm.

Kandula's Birthday Celebration

November 19—10 a.m. to 4 p.m.

Join the National Zoo and the Embassy of Sri Lanka as we celebrate male Asian elephant Kandula's fifth birthday with a romping good time. At this free event, enjoy entertainment, refreshments, and interpretive talks by Zoo keepers. The embassy will present a ceremonial costume to Kandula. For more information, visit www.fonz.org/elephants.htm.

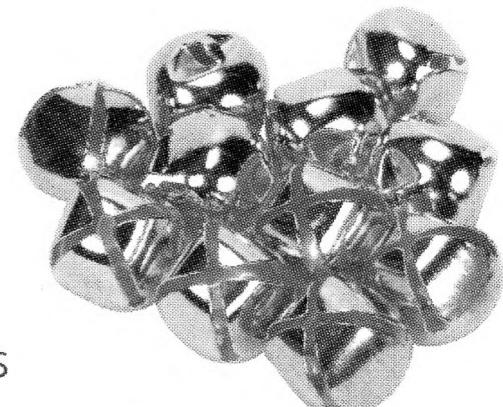


Jessie Cohen/NZP

Jingle in the Jungle

December 7—6 to 9 p.m.

Ring in the holiday season at this festive FONZ Young Professionals event. Enjoy twinkling lights, beer, and appetizing hors d'oeuvres while mingling with other area young professionals. For more information and to purchase tickets, visit www.fonz.org/afterhours.htm.



Shop National Zoo Stores

Need a special gift for the animal lover in your life? Look no further than the National Zoo. You'll receive a member discount at all stores in the Zoo, including the new Asia Trail Shop, and at the Holiday Zoo Store on the second floor of Westfield Shoppingtown Montgomery Mall. Or, shop online at <http://store.fonz.org>.

Lectures

All lectures at the National Zoo are free and open to the public. For more information and to RSVP, visit www.fonz.org/lectures.htm.

Thumbs, Toes, and Tears

November 2—7 p.m. book signing, 7:30 p.m. lecture

Science journalist, documentary filmmaker, and former CNN bureau chief Chip Walter will talk about his new book, *Thumbs, Toes, and Tears, And Other Traits That Make Us Human*. He will explore six fascinating and seemingly unconnected human traits—big toes, thumbs, pharynxes, tears, kissing, and laughter.

Conserving Asian Elephants in Sri Lanka and Beyond

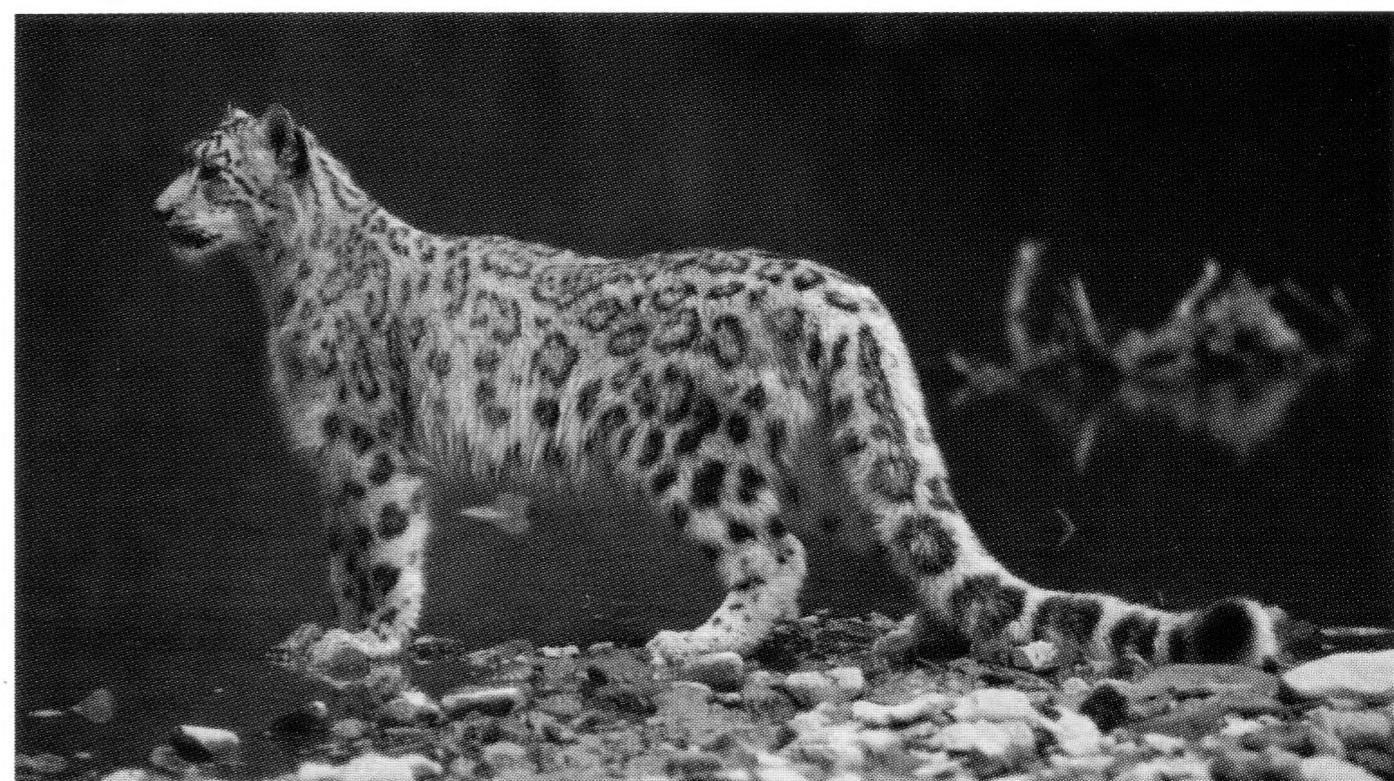
November 16—7:30 p.m.

Asian elephant Shanti came to the Zoo in 1976 as a gift from the children of Sri Lanka. Her male calf, Kandula, turns five in November, and as part of the Zoo's celebration of his birthday, the Embassy of Sri Lanka is sponsoring this lecture. Prithiviraj Fernando, a Zoo research collaborator who has studied Asian elephants for almost a decade, will talk about conservation of this magnificent species. He is affiliated with the Centre for Conservation and Research in Sri Lanka, where he helps lead conservation efforts.

Snow Leopards and Other Wildlife Wonders of the Himalayas

November 29—7:30 p.m.

Sandeep Sharma, now a George Mason University/National Zoological Park Doctoral Fellow, and his wife, biologist Trishna Dutta, have studied snow leopards in the high mountains of Ladakh, India, in the Himalayas. Sharma will talk about their work with these beautiful cats as well as their experiences with other wildlife of the region, including Tibetan wolves and blue sheep.



Snow leopards and other Himalayan wildlife are the topic of the November 29 lecture.

Statement of Ownership

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Asia's Elusive Acrobat

The clouded leopard could be called a little big cat. It's got the head of a big cat on a small cat's body. An adult female weighs just 25 to 35 pounds—about as much as a two- or three-year-old child—and an adult male may weigh about double that. Even the largest clouded leopard (*Neofelis nebulosa*) is lilliputian when compared with the heavy hitters with which it shares the subfamily Pantherinae, including lions and tigers, which tip the scales at up to 500 and 570 pounds, respectively.

BY HOWARD YOUTH

Thanks to flexible ankle joints, clouded leopards can leap onto precarious branches and climb down tree trunks headfirst. While their agility is unequivocal, much of their behavior is still unknown.







Bruce Coleman Inc./lynne M. Stone

What scientists don't know about clouded leopards could hurt the cats. Breeding the species in zoos is notoriously difficult, because no one knows why male clouded leopards often kill females upon introduction.

You aren't likely to see a clouded leopard unless you visit one on the Smithsonian National Zoo's Asia Trail, or at another zoo. This cat has the vanishing skills of David Copperfield and the grace and agility of Jackie Chan, yet lacks the celebrity of either. It skulks in one of the world's most crowded corners and no one knows exactly how well it is doing. But most experts believe it has fallen on hard times over large parts of its range, from southern China to the eastern Himalayas and south to Sumatra and Borneo. There, satellite images depict habitat scraps left in areas once blanketed by forest. Even where ample habitat remains, clouded leopards are extremely difficult to find. You are far more likely to spot a wild clouded leopard's gray-, brown-, and black-swirled coat hanging in a market in China, Cambodia, Laos, Myanmar, Nepal, Thailand, or Vietnam, where illegally obtained pelts, in the absence of the real thing, may sell as "tiger skins."

Under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, international trade in clouded leopards is banned. But that hasn't stopped a surging demand in Asia for the animals' fur, teeth, and bones, which are used in traditional medicine. While listed as vulnerable on the 2006 IUCN Red List of Threatened Species, clouded leopards get endangered status on the U.S. Fish & Wildlife Service's endangered species list. Such designations, however, did not save the distinct subspecies of clouded leopard that inhabited Taiwan, where its fur was prized for ceremonial use. The last confirmed sighting of a clouded leopard there was in 1983.

For the past four years, National Zoo reproductive physiologist JoGayle Howard and her colleagues have been taking new steps to improve the clouded leopard's prospects. In 2002, Howard and Nashville Zoo President Rick Schwartz initiated the Thailand Clouded Leopard Consortium, an international effort that supports clouded leopard conservation in the wild in Thailand and works to improve breeding success of clouded leopards in Thai zoos. Participants include the National and Nashville zoos, Khao Kheow Open Zoo in Chonburi, Thailand, the Zoological Park Organization of Thailand, the Asian Wildlife Consultancy, and the Clouded Leopard Species Survival Plan (SSP), which manages North American zoo breeding and research efforts. Khao Kheow Open Zoo is the consortium's headquarters and the site of the clouded leopard breeding program in Thailand. For four years now, the consortium has been forging ahead with its efforts to save a particularly cagey cat.

Mystery Cat

How many clouded leopards remain in the wilds of Asia? One often-quoted estimate is fewer than 10,000. "The truth is, there have been no surveys, no numbers in the wild—we don't know if there are 10,000 out there," says Howard.

So far, only six wild clouded leopards have been radiocollared and tracked, all of them within Thailand. In the late 1990s, Sean C. Austin, a biologist working for the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville, radiotracked one male

and one female clouded leopard for 15 months in Khao Yai National Park, northeast of Bangkok. He found his subjects to be "very active in terms of movement and distances traveled." The female had a home range of 12.8 square miles and the male of 14.2 square miles. "The size of the areas used," he wrote, "is surprising as these areas greatly exceed the size of male leopard (*Panthera pardus*) home ranges [6.9 square miles] elsewhere in Thailand." Based on the distances traveled and movement patterns, Austin supported earlier assertions that while clouded leopards may rest in trees, they almost certainly do much of their moving around and hunting on the ground. "It would be difficult," he wrote, "to cover these daily distances without spending much time on the ground."

Between 2000 and 2003, biologist Lon Grassman, also with the Caesar Kleberg Wildlife Research Institute, radiocollared and tracked two male and two female clouded leopards in the Phu Khieo Wildlife Sanctuary in northeastern Thailand. Grassman tracked each animal for between seven and 17 months and found that all four had considerable overlap in their home ranges, which spanned between 8.8 and 17.4 square miles. But not all used the same habitats. While closed-canopy forest comprised 84 percent of the home ranges, one male used an open-canopied forest and grassland habitat more than expected. Grassman found that his cats' activity did not follow a fixed pattern but that most activity occurred at dawn or dusk or at night. Austin's and Grassman's data helped change perceptions of an animal once assumed to be a strictly nocturnal, arboreal forest hunter.

Aside from these six radiocollared cats and photos taken by motion-detecting infrared cameras, there is little more than speculation about the clouded leopard's remaining distribution, natural history, and conservation needs. Much of what we do know comes from anecdotal information or from observations made at zoos, including our knowledge of the clouded leopard's almost mythical agility. "I call them the acrobats of the forest," says Howard. "They can jump ten to 12 feet from tree to tree, balance on little branches, and traverse a

horizontal tree trunk upside down." They can also hang upside down from a branch using just their hind legs, and clamber head-first down a vertical tree trunk, thanks to their very flexible ankle joints.

To aid them in their arboreal activities, clouded leopards have large, sharp-clawed paws, short legs, and long tails that provide balance. Their bodies may be up to three feet long, but their sweeping tails tack on at least another 30 inches. In the dwindling number of areas where tigers or leopards share their habitat, clouded leopards no

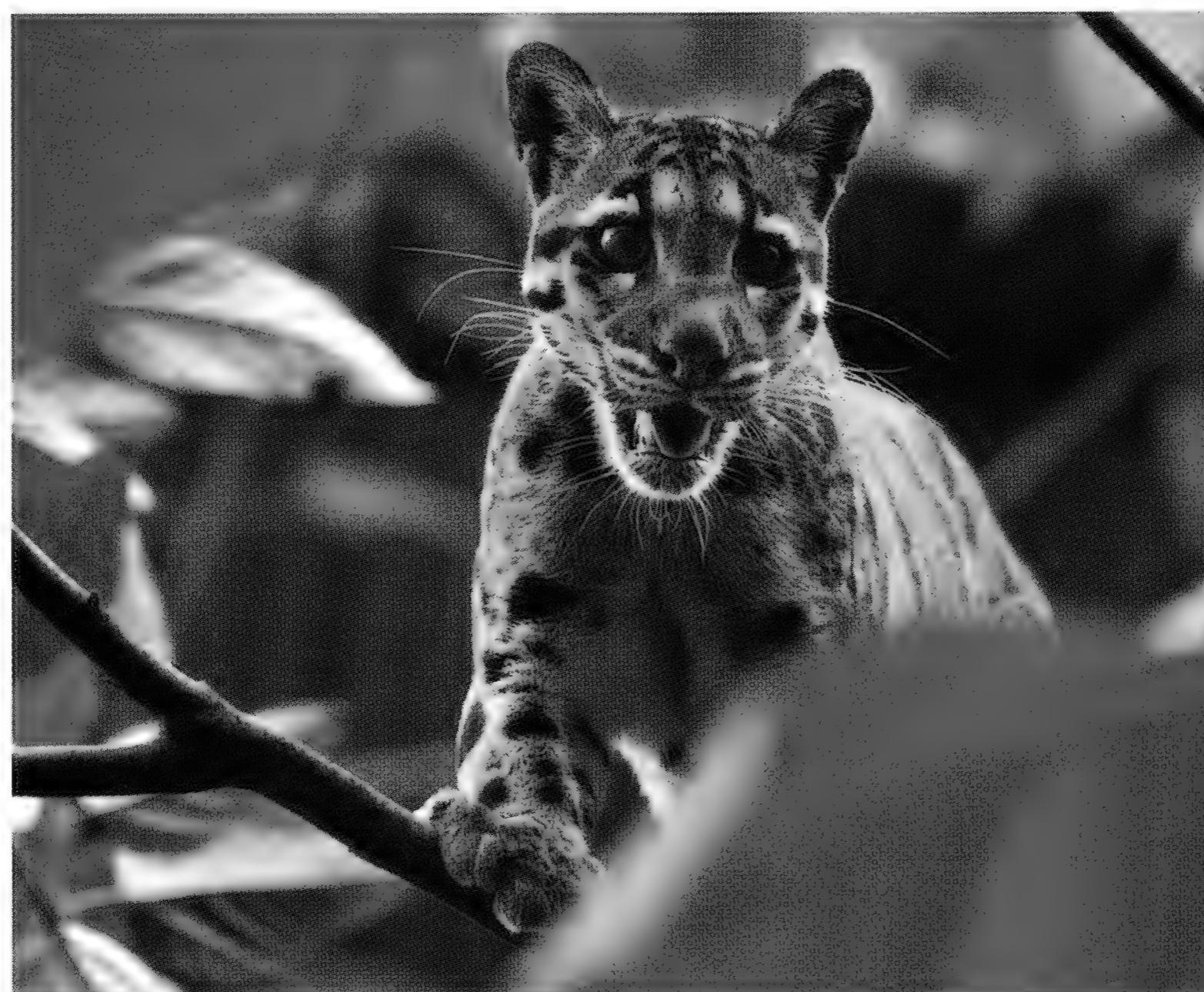
doubt employ their camouflaging coats and tree-climbing abilities to hunt and to avoid becoming dinner themselves.

Clouded leopards' fearsome dentition hints at their killing power. They have the longest canines, relative to body size, of any feline, which they use to kill a variety of terrestrial and arboreal creatures. Grassman collected and analyzed wild clouded leopard feces, or scat, in Thailand during his study, and also compiled observations of clouded leopards' hunting activity. According to his data, the following species are clouded leopard prey: red muntjac (*Muntiacus muntjak*), Java mouse-deer (*Tragulus javanicus*), hog deer (*Axis porcinus*), Asiatic brush-tailed porcupine (*Atherurus*

macrourus), Indochinese ground squirrel (*Menetes berdmorei*), Malayan pangolin (*Manis javanica*), slow loris (*Nycticebus coucang*), Phayre's leaf-monkey (*Trachypithecus phayrei*), and mice. In other places, clouded leopards are known to eat wild birds, poultry, wild boar, and even orangutans (*Pongo* spp.).

Stalking Cats and Their Hunters

In 2003, with hopes of learning more about clouded leopard distribution while bolstering park protection efforts in Thailand, Howard and Peter Leimgruber, an ecologist at the National Zoo, started the Thailand Carnivore Conservation Project. This collaboration between the Zoo, the international wildlife trade watchdog WildAid, the Cincinnati Zoo, and the Thailand Department of National Parks, Wildlife, and Plant Conservation includes monitoring, ranger



Jessie Cohen/NZP

They can jump ten to 12 feet from tree to tree, balance on little branches, and traverse a horizontal tree trunk upside down.

training, and a field survey of carnivores that will culminate in a GIS map of their distribution.

The project began at Khao Yai National Park in 2003, when 20 rangers attended an ecology workshop. Six of the attendees were selected to form the Carnivore Monitoring Team. As part of their training, these rangers learned to identify tracks of different carnivores from plaster casts made from paw prints, and to identify and record any other signs—scrapings, rubbings, scat—that they come across in the forest.

Data collection began in 2004. The rangers set up, checked, and rotated 20 motion-detecting infrared cameras bought with funds raised by Friends of the National Zoo's Young Professionals program and donations from other North American zoos. The cameras were strapped to trees and moved after a month to other parts of the park, their film taken out for developing and replaced with fresh rolls. While checking the cameras, rangers also looked for other signs that carnivores were present, including tracks and claw marks on trees.

The first year, the cameras photographed Asian black bears (*Ursus thibetanus*) and sun bears (*Helarctos malayanus*), but no clouded leopards. The next year yielded five photos of clouded leopards. At the base of one tree, a camera snapped shots of wild cats from three other species: leopard cat (*Prionailurus bengalensis*), Asian golden cat (*Catopuma temminckii*), and marbled cat (*Pardofelis marmorata*).

The cameras caught more than just wildlife. They also documented many intrusions by humans into the cats' habitat. "On almost every roll of film there are people," says Howard. "The park closes at night but there is a lot of illegal activity. Most people in the photos are carrying a gun or have a dog with them. It's pretty safe to say that these people are poachers." In addition to animals, aloe wood is also being removed from the park for use in lotions and perfumes. "Poaching is all over the park," says Howard. At about 535,700 acres—a bit larger than Great Smoky Mountains National Park in North Carolina and Tennessee—Khao Yai is one of Thailand's most expansive conservation areas, but it has only a small staff to patrol its borders and interior. "It's hard to track poaching there, it's a huge area. But there are several hotspots and we're now plotting the frequency of occurrences," says Howard.

This effort is intended to be ongoing, and Khao Yai, just one link in a network of five connected parks, was just the beginning. "Our team is ready and has been invited to expand into the next park," says Howard, who is now trying to raise funds for field cameras and training at nearby Thap Lan National Park.

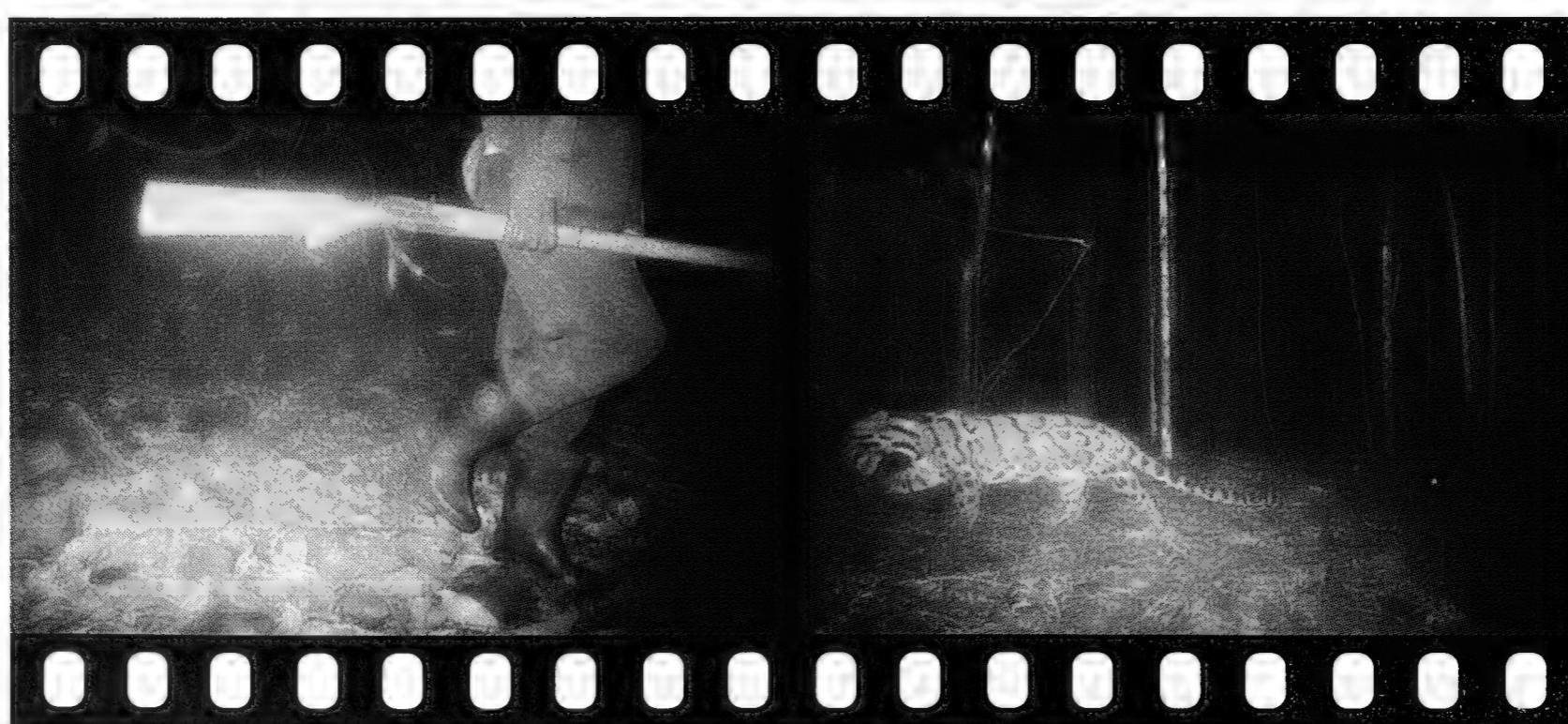
Matchmaking: A Dicey Proposition

If all goes well, a female clouded leopard gives birth to two to five cubs following a gestation period of between 86 and 93 days. This cycle has played out many times at the Zoo's Conservation and Research Center (CRC) in Front Royal, Virginia, where breeding efforts and reproduction studies for the species have been underway since 1978.

A total of 72 clouded leopards have been born at CRC; many were sent to other North American zoos as part of the ongoing SSP, which aims to create a self-sustaining zoo population. Yet this

remains a distant dream, primarily because unbonded males often attack and kill females upon introduction. "Male aggression is the number-one problem," says Howard. "We're still trying to figure out why males behave like this." As a result, it's been very difficult to mix and match animals to create a varied zoo gene pool.

Across North America, 99 clouded leopards residing at 34 zoos have been part of the SSP. But due to the difficulty in successfully pairing animals, most of the current zoo population is descended from only seven founders. To date, no SSP males have bred with more than one female. (Outside of North America, there are 128 clouded leopards in 38 zoos.)



Thailand Carnivore Conservation Project

Enter Thailand, a country with conservation infrastructure and the largest zoo clouded leopard population in Asia. Unlike North American populations, the Thai zoos' clouded leopard populations exhibit rich genetic diversity. In 2002, the Zoological Park Organization of Thailand (ZPO) maintained a total of 27 clouded leopards in their five zoos, 24 of which were born in the wild and then either given to zoos or confiscated from poachers by wildlife authorities. Because of their wild lineage, these animals were an excellent foundation for beginning a breeding program.

Howard and the Nashville Zoo's Rick Schwartz made a proposal to the ZPO to develop a collaborative international program to





Jogayle, a cub born in the Thailand breeding program.

improve its clouded leopard husbandry and nutrition and to begin a breeding program. Once the consortium was set up in 2002, all five ZPO zoos sent a total of 23 clouded leopards to the new breeding program at the Khao Kheow Open Zoo.

After the animals arrived at Khao Kheow, the key was to find ways to make pairs that would breed and not fight. Ken Lang, a National Zoo carnivore specialist who has worked at CRC for 28 years, was the Thai consortium's first onsite manager. Lang has mastered the ability to match clouded leopards—a process Howard calls “more an art than a science.” With modesty, Lang says, “I’ve experimented over the years with various combinations of possibilities. It had a lot to do with the different personalities of the cats, but age makes a big difference.”

Lang and other SSP clouded leopard experts find that males younger than a year are usually very easy to match with females, and that males younger than two still have a fairly good chance of matching successfully, depending upon the cats’ temperaments. Clouded leopard males older than two that have reached puberty are far more likely to attack introduced females. Now that the consortium’s breeding activities are up and running, some pairs that bonded early on in Thailand will be sent to the United States to augment genetic diversity in the SSP.

Meanwhile, the first Khao Kheow cubs to reach the United States may soon meet each other. Right now, Lang is finishing up

Juan Rodriguez

a four-month attempt to match a Khao Kheow female named Jogayle with a male born at the Point Defiance Zoo and Aquarium in Tacoma, Washington, named Rama. The pairing has been rocky, so Jogayle will be sent to the Nashville Zoo to meet an unrelated Khao Kheow male named Dao, which has a gentle disposition. Lang says that hand-reared animals, such as those from Khao Kheow and CRC, are far easier to work with because they are generally not as skittish as wild cats and thus easier to observe. “A lot depends on how much the animals trust you,” says Lang, “and how much they’ll do in front of you. Other cats will just sit in the nest box and hide.”

A Flare for Things Scatological

Elsewhere at the Zoo, other clouded leopard research is being done that requires no cat observations at all. Zoo scientists have pioneered noninvasive hormone monitoring that enables

them to learn about wildlife without disturbing, or even seeing, their subjects. Zoo reproductive health specialist Katey Pelican oversees lab work that has revealed a lot about clouded leopards from scat samples collected daily at the Khao Kheow Open Zoo. Since 2002, Pelican, Kate MacKinnon, a Washington State University graduate student who works as a technician, Howard, and their colleagues have analyzed more than 20,000 fecal samples.

What can you learn from scat? First, by measuring reproductive and stress hormone levels in samples from 23 clouded leopards, Pelican’s team confirmed why, at the beginning, Khao Kheow’s cats were neither thriving nor reproducing. Nutritional analysis confirmed that

the cats were eating an unbalanced diet that, among other things, was very low in calcium. Stress hormone levels indicated that the small, low enclosures in which the cats lived, many close to tigers, bears, and other large carnivores, left the cats nervous and insecure.

“They had no access to height, which is very important,” says Pelican. At the new Asia Trail at the National Zoo, for example, visitors see two clouded leopards in an exhibit that is about 15 feet tall. To address the need for height and shelter at Khao Kheow, Ken Lang used tall vacant hornbill aviaries from the zoo that were outfitted with climbing structures and nest boxes where the cats could hide and raise their young. The enclosures already included lush vegetation that provided extra cover, and sat well away from tigers,

Future zoo cubs may be reintroduced into wild areas where clouded leopard populations have been eradicated or reduced to dangerously low levels.

bears, and other carnivores. The clouded leopards' diet was changed from chicken parts to live quail and fresh, whole chicken, with vitamin and mineral supplements added.

How did a change of diet and space affect the cats? At the beginning of the program in 2002, only half of the females exhibited estrous cycles, and tested males had low sperm counts. About six months into the project, however, most of the females that had not been cycling started to. Males also had high sperm quality. "The data are clear," says Pelican. "Those management changes were important for a successful breeding program for clouded leopards in particular and carnivores in general because carnivore managers around the world often do not provide a proper, balanced diet with sufficient calcium, or enclosures that make the animals comfortable."

But that's not all scat has to tell us about clouded leopards and other wildlife. Fecal samples from 19 Thai carnivore species kept at Khao Kheow, including civets, bears, jackals, and various cats, were sent to the National Zoo. There, geneticist Lori Eggert, through genetic sequencing, created DNA markers that make it easy to differentiate between species. This work confirmed that genetic tests can be used to identify species in the wild by their scat samples. It's an important advance that allows rangers and researchers to survey the distribution and density of wildlife populations without seeing or capturing clouded leopards.

The research team also put fecal samples to the test under varied conditions to determine how long it takes for scat to lose its DNA and hormones. Tested in shade, sun, and in wet and dry seasons, Khao Kheow samples gave the scientists information on the rate of DNA and hormone degradation under field conditions and how valuable new or old scat will be when collected in the field.

A Clearer Future for Cloudeds

As with this scat analysis, Zoo researchers and their colleagues, whenever possible, tie together field and zoo efforts, and Thai and North American interests. They have facilitated meetings between rangers and zoos so that those in the field can see, up close and personal, the cats they are working to save. They also bring keepers to meet the field team. These days, Khao Kheow keepers take more interest in the animals for which they care. "Now they want to do the behavioral observations. They want to see the babies being born," says Lang. In May and June 2006, the keepers used nest-box cameras to monitor and video-record births in the latest two litters.

After returning from Thailand and compiling their data, Howard and other Zoo researchers share results with their Thai colleagues. "We teach them so that they'll be able to take over," says Lang. "They see we're not just going in there and taking. The partnership benefits them."

Within the consortium, North American zoos, including the Nashville Zoo, Point Defiance Zoo, Brookfield Zoo in Brookfield, Illinois, the Bergen County Zoological Park in Paramus, New Jersey, and the National Zoo, have contributed employees and their time for stints in Thailand. "It's always been a multi-zoo effort. Now we've got more interest because people see the success we're having and the long-term nature of it," says Lang. Former National Zoo keeper Rick Passaro now manages the program full time at Khao Kheow, working with the Thai staff and the revolving cadre of North American zoo personnel.

"Our greatest success," says Lang, "has been the number of babies." So far, 13 cubs have been born and survived to contribute to the breeding program, including the two that were exported to

CRC and the Nashville Zoo. Now four years old, the Thai breeding program will continue for at least three more years after the recent signing of a memorandum of understanding between Thai and North American zoos. Although there are no formal plans now, some day future zoo cubs also may be reintroduced into wild areas where clouded leopard populations have been eradicated or reduced to dangerously low levels.

Thailand is home to nine wild felid species, very few of which have been well studied or surveyed. These clouded leopard programs provide an example and hope for work with other declining cat species. Howard and the Cincinnati Zoo's Bill Swanson, for example, recently spearheaded a similar breeding program and field survey for fishing cats (*Prionailurus viverrinus*). Meanwhile, clouded leopards remain a worry for conservationists in a country with dwindling forest cover, shorn down from about 50 percent in the 1960s to about 20 percent by 2000. "The good news is that we're working on saving clouded leopards at the right time, the right place," says Howard. "It's not too late for them." Z

—Contributing editor Howard Youth's recent ZooGoer articles have focused on Florida panthers, desert tortoises, and black-footed ferrets.



In the Thailand Carnivore Conservation Project's training program, park rangers learn to identify clouded leopard tracks.

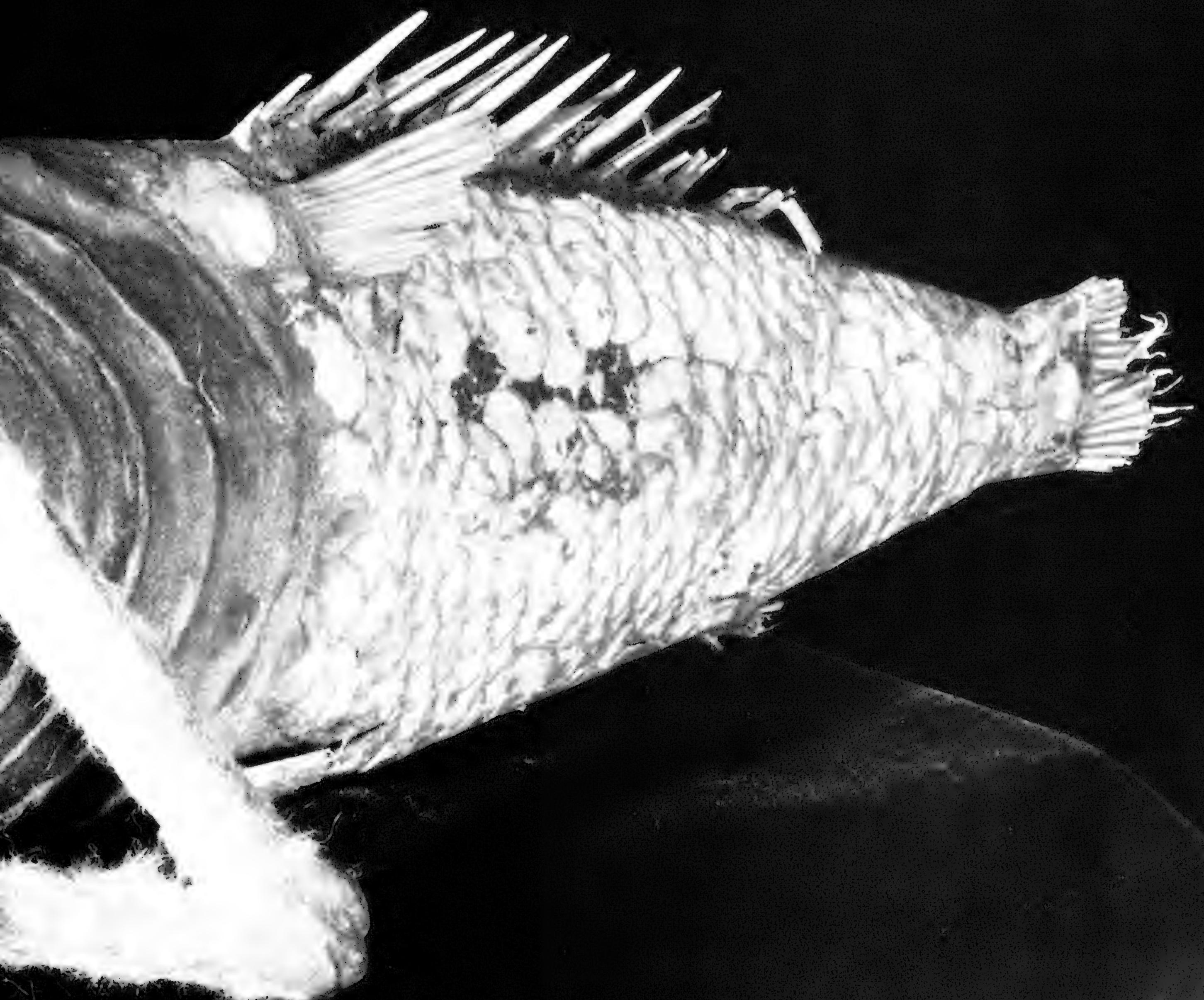
Kate Jenks



With a clever marketing scheme, showman P.T. Barnum duped thousands of New Yorkers into believing that the faked skeleton of the Feejee Mermaid was authentic.

the UNICORN,
the *mermaid*,
and the centaur

BY ROBIN MEADOWS



People have been perpetrating—and falling for—mythological hoaxes for centuries. Among the most amazing are a unicorn skeleton assembled by a German scientist in the 1600s, a preserved mermaid exhibited by P.T. Barnum in the 1800s, and a Greek centaur excavation faked by an American biologist in the 1990s.

Why did they do it? “There are many reasons for hoaxes, from playfulness to maliciousness to greed for money or attention,” says Neil Greenberg, an ecologist at the University of Tennessee, Knoxville.

And why should we care? The motives behind these hoaxes, as well as our reactions to them today, show how far we have come in deciphering fossils and other biological remains, which is key to understanding the history of life on Earth.

Greenberg knows about the reasons for hoaxes firsthand because he is one of the perpetrators of the centaur hoax. But while he does so knowingly, with the intent to teach, the unicorn hoax probably started as an honest mistake.

Leibniz's Unicorn

The supposed unicorn skeleton was given credence in the mid-1700s by Gottfried Wilhelm von Leibniz, one of the greatest naturalists and philosophers of his time. Paleontology was in its infancy, and Leibniz documented all the fossils he knew of in his book *Protogaea, or A Dissertation on the Original Aspect of the Earth and the Vestiges of Its Very Ancient History in the Monuments of Nature*, published in 1749. At the end of the book, after pages of drawings of real fossils from shells to fish imprints, he included a sketch of a unicorn skeleton. The accompanying text cites a 1663 paper by noted scientist Otto von Guericke, who wrote that the “skeleton of a unicorn” had been dug up in a quarry in Germany’s Harz Mountains near the town of Quedlinburg. Leibniz then goes on to say that,

As is usual with such brutes, its posterior parts were very low and its head raised. Its forehead bore a horn nearly five ells long, as thick as a man’s thigh but gradually tapering. Because of the ignorance and carelessness of the diggers, the skeleton was broken and extracted in pieces. However, the horn, which was attached to the head, several ribs, and the backbone were brought to the abbess of the town.

The fact that the horn was attached to a fragment of bone was one of the strongest points in favor of the interpretation that this was indeed a unicorn skeleton.

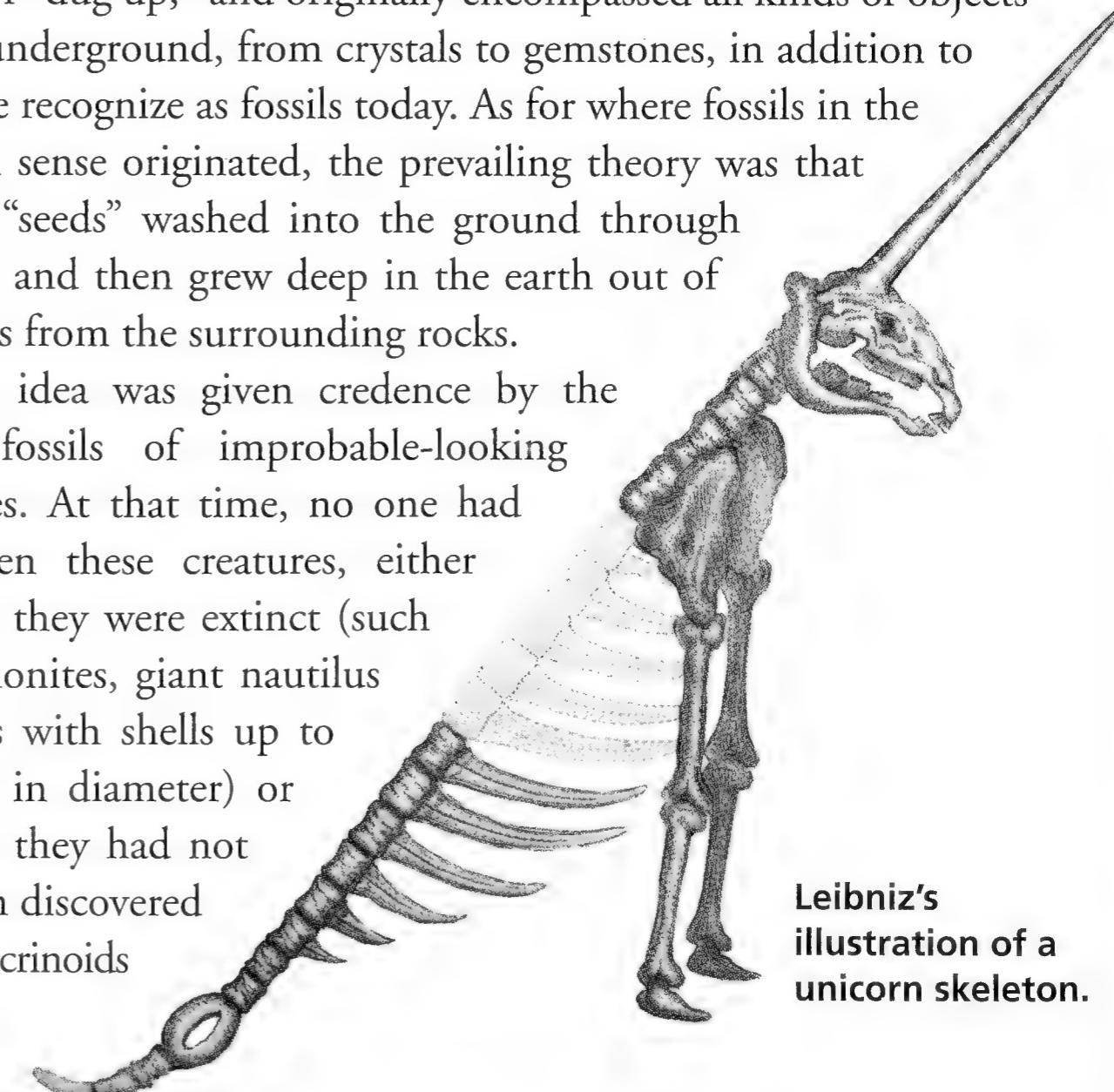
To modern eyes, Leibniz’s unicorn looks preposterous. There are obvious problems with the skeleton as assembled, beginning with the glaring lack of hind legs and the resulting extreme slope of the

backbone, which juts at a 45 degree angle from the skull so that the tailbone rests directly on the ground. More subtly, the bones are put together wrong, with the spinal column backward so that the skull and neck vertebrae are attached to the tail end. Finally, the bones come from more than one kind of animal. The skeleton in the drawing has since been identified as a mix of rhinoceros and mammoth bones. The unicorn’s horn is likely to be a young mammoth’s tusk: These long teeth are straight and grow out of the jawbone, thus explaining the bone fragment at the base of the “unicorn horn.”

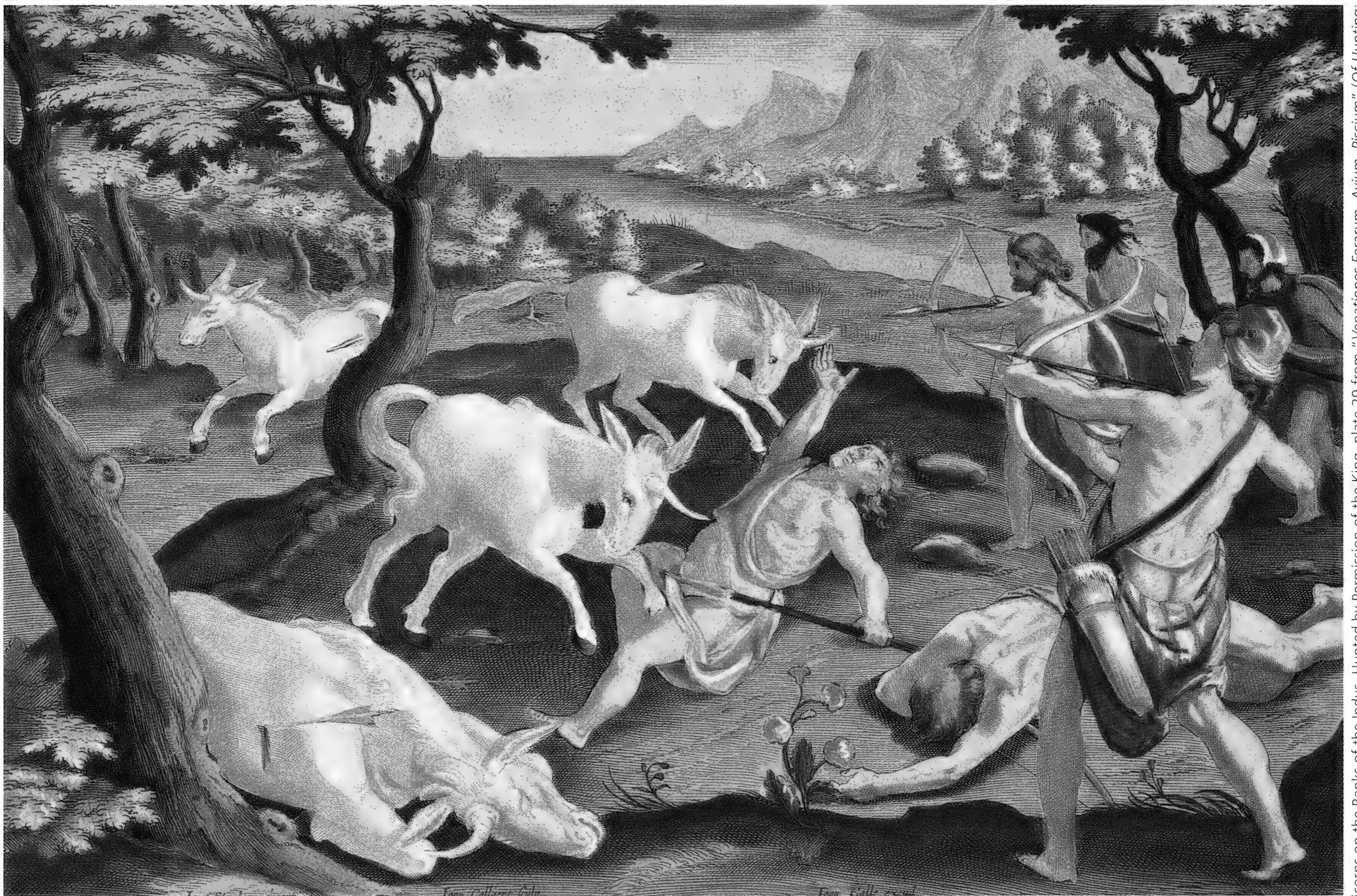
It’s easy to laugh. After all, how could Leibniz and his contemporaries actually believe in unicorns? Because they were going on the best evidence available to them at the time. The assembled skeleton came on the heels of eyewitness accounts from Portuguese travelers, who claimed to have seen a living unicorn in Abyssinia (now Ethiopia). And, people had accepted unicorns as real creatures for more than 2,000 years. The Greeks included unicorns in their natural histories as early as the fifth century B.C.E., presenting them as fact rather than myth, and European scholars continued to assert the existence of unicorns well into the 1700s.

Moreover, naturalists were still trying to make sense of fossils during Leibniz’s time. Back then, most people didn’t even realize that fossils were the remains of living things. The word “fossil” comes from the Latin for “dug up,” and originally encompassed all kinds of objects found underground, from crystals to gemstones, in addition to what we recognize as fossils today. As for where fossils in the modern sense originated, the prevailing theory was that animal “seeds” washed into the ground through fissures, and then grew deep in the earth out of minerals from the surrounding rocks.

This idea was given credence by the many fossils of improbable-looking creatures. At that time, no one had ever seen these creatures, either because they were extinct (such as ammonites, giant nautilus relatives with shells up to six feet in diameter) or because they had not yet been discovered (such as crinoids



Leibniz’s illustration of a unicorn skeleton.



As long ago as the fifth century B.C.E., unicorns were depicted as real animals in art, folktales, and natural histories. Some European scholars avowed unicorns' existence as late as the 1700s.

or sea lilies, which are related to sea stars but resemble plants and can grow to be three feet across). "In many ways, it was less outlandish to believe that stones would sometimes mimic the forms of the animal world than to believe that animals could turn to stone," says J. Bret Bennington, a paleontologist at Hofstra University in Hempstead, New York, in his online publication "A Short History of Paleontology."

The idea that fossils come from real animals can be traced back to ancient Greeks in the sixth century B.C.E., when Pythagoras and Herodotus deduced that stone shells and fish imprints were remnants of living creatures. Likewise, Leonardo da Vinci and other luminaries through the ages had figured it out, and were proven right soon after Leibniz described the unicorn. By the early 1700s, people had discovered fossils of so many forms of life, as well as living creatures corresponding to so many of the improbable-looking fossils, that the organic origin of fossils was finally widely accepted.

The Feejee Mermaid

While Leibniz's unicorn was an honest mistake, the Feejee Mermaid was an outright lie. Phineas Taylor Barnum knew full well that the mermaid was a fake when he presented it as the real thing in his American Museum in New York City in the 1840s, and he went to great lengths to hoodwink the public.

It helped that the mermaid was so skillfully constructed that it had already fooled many people, beginning with the Boston sea captain who brought it to London in the early 1820s. The story goes that Captain Samuel Barrett Eades bought the mermaid from Dutch merchants, who in turn had bought it from a Japanese fisherman who claimed to have caught it in his nets. Eades evidently believed that he had lucked into a great treasure, because he sold his ship and cargo to pay for the mermaid. While the three-foot-long dried specimen did have the basic mermaid components of a woman-like top and a fishy tail with no obvious discontinuity between the two halves, it was

hardly the beautiful creature of folklore. The mermaid was downright homely, with a grotesque face and an assortment of spines and spiky fins. Even so, when Eades brought the mermaid to London, a number of British naturalists verified its authenticity in scholarly articles.

In 1842, Eades' son sold the mermaid to an American showman who then leased it to P.T. Barnum. With the help of an accomplice, Barnum set to work constructing an elaborate hoax around the mermaid. First, he created a buzz by planting anonymous letters in newspapers saying that the famous British naturalist Dr. Griffin was coming to the United States with a mermaid caught off the Feejee Islands. Barnum's accomplice then posed as Dr. Griffin and grudg-

Unicorns on the Banks of the Indus, Hunted by Permission of the King, plate 29 from "Venationes Ferarum, Avium, Piscium" (Of Hunting: Wild Beasts, Birds, Fish) engraved by Jan Collaert (1566-1628) published by Philipus Gallaeus of Amsterdam (hand colour), Straet, Jan van der (Joannes Stradanus) (1523-1605) (after) Private Collection, The Stapleton Collection/The Bridgeman Art Library International



This 15th-century illustration depicts a mermaid, or siren, trying to tempt Saint Brendan as he travels by sea.

ingly showed the mermaid to the press in Philadelphia, who obligingly wrote stories vouching for its authenticity. Next, Dr. Griffin repeated the scam in New York City, getting even more free publicity and further piquing the public's interest. Only then did Barnum enter the fray, saying that he wanted to display the mermaid but that Dr. Griffin refused to let him. By the time Barnum finally exhibited the Feejee Mermaid, people were so excited that they thronged to see it. And Barnum made thousands of dollars per week, a small fortune at the time. As he is reputed to have said, "A sucker is born every minute."

Today, the Feejee Mermaid is listed among the holdings of Harvard University's Peabody Museum of Archaeology and Ethnology, where it was long believed by museum curators to have been made by sewing the head and torso of a monkey to the tail of a fish. In 1990, a curator at the museum ran some tests on it and discovered that the top half was really made of papier-mâché, the tail was a

decapitated salmon, and the sharp teeth, spiny "fingernails," and various fins were from a carp.

Like Leibniz's unicorn, the Feejee Mermaid is easy to laugh at today. How could so many people have fallen for it? For one thing, like unicorns, mermaids had been reported since the time of the ancient Greeks. Furthermore, mermaids were still being reported by eminently respectable men, including explorer Henry Hudson, who said he saw a mermaid while searching for the Northwest Passage between the Atlantic and Pacific oceans, as late as the 1600s. And mermaid sightings had been reported off the coast of Scotland as recently as the early 1800s, just decades before Barnum displayed the Feejee Mermaid. Another reason so many people were fooled was that Barnum cleverly exhibited the mermaid alongside other creatures that look like fantastical hybrids but really do exist, including a swordfish and a duck-billed platypus. Newspaper advertisements blurred the line between fact and fiction, describing the platypus as "half-bird, half-beast" and the mermaid as "half-fish, half-human."

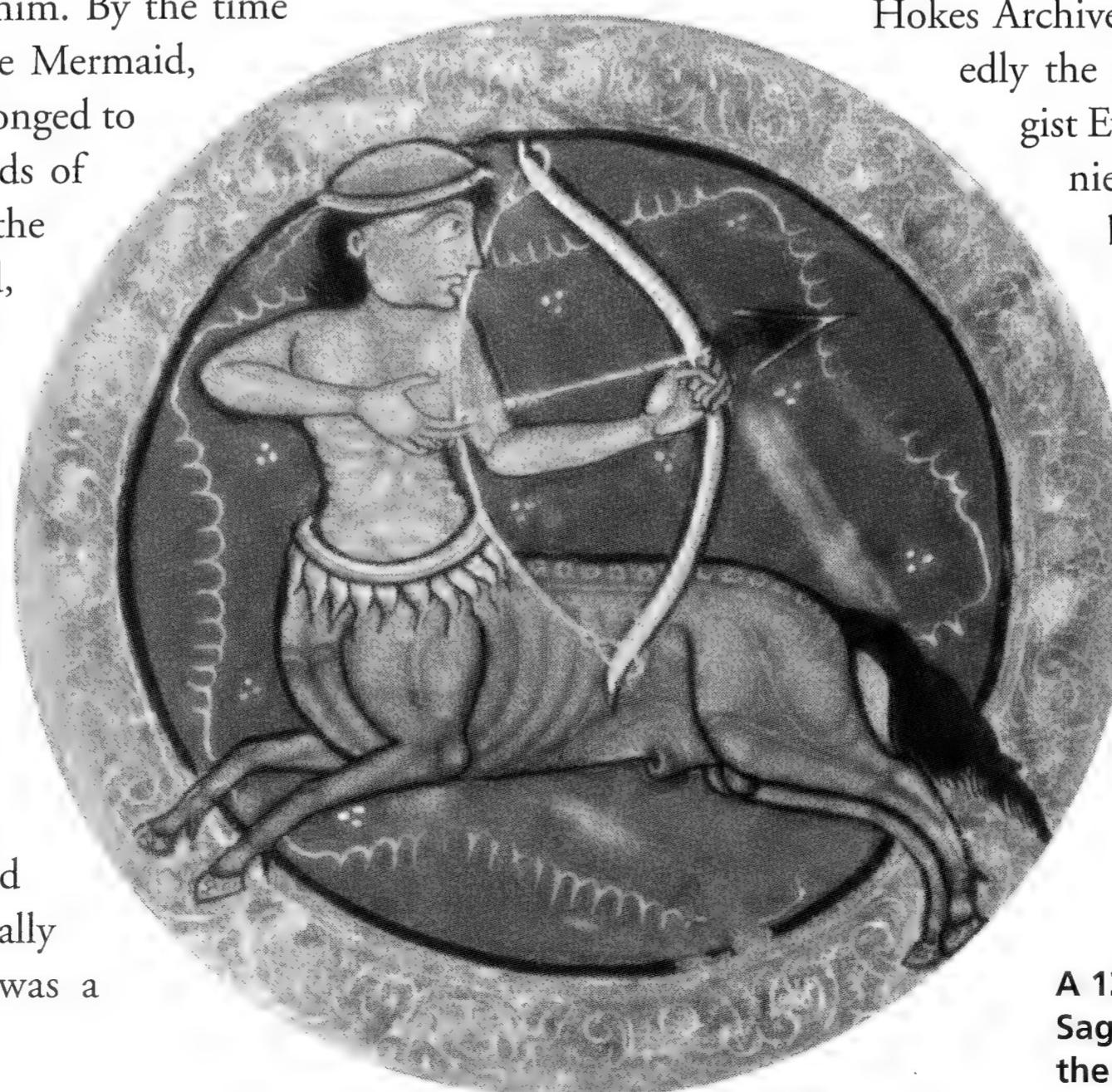
The Centaur of Volos

While the Feejee Mermaid hoax was intended to deceive, the Centaur of Volos hoax is intended to teach. Volos is a real city in Greece, but all the rest is pure fantasy. The centaur skeleton was assembled in the 1980s by William Willers, then a biology professor at the University of Wisconsin, Oshkosh. Willers combined bones from a Shetland pony and a human skeleton that had previously been used in an anatomy class, and stained them with tea to make them look old.

In 1994, biology professor Neil Greenberg and art professor Beauvais Lyons brought the centaur skeleton to the University of Tennessee, Knoxville. The centaur was a perfect fit with their extracurricular interests. Greenberg periodically offers a class called "Biological Mythology" and once sponsored a forum called "Zoological Hoaxes as Catalysts for Critical Inquiry." Lyons is Director of the

Hokes Archives (Get it? Say it out loud!), purportedly the collected works of British archaeologist Everitt Ormsby Hokes, who was conveniently omitted from historical accounts but supposedly discovered several obscure cultures that have been neglected by contemporary archaeologists.

Greenberg and Lyons' centaur display looks like it belongs in a natural history museum. A glass-topped case contains the centaur skeleton, which is partially embedded in a sandstone slab and surrounded by inscribed clay tablets. The accompanying text says the skeleton dates to about 1300



A 12th-century depiction of Sagittarius, the centaur for whom the constellation is named.

B.C.E. and that it is "one of three centaur burials discovered in 1980 by the Archaeological Society of Argos Orestiko, eight kilometers northeast of Volos, Greece." Rounding out the display are a map of Greece, a print of centaur anatomy, and ancient-looking pottery. When Lyons asked a student looking at the display, "Do you believe in centaurs?" the answer was, "I'm not sure but it sure looks authentic." Which is precisely the point of the hoax. "I want my students skeptical. Science is not a pile of facts and bones," says Greenberg, adding that science is "acts of critical inquiry, driven by imagination and reined in by logic."

Why Getting Paleontology Right Is Important

Even in modern times, the boundary between the possible and the impossible is not always clear-cut. The idea that birds evolved from dinosaurs has been hotly contested since first being proposed in the late 1800s, although it is generally accepted that the weight of evidence supports it today. And the jury is still out on exactly where whales came from. Once thought to have evolved from hooved carnivores called mesonychids that lived between 60 and 30 millions years ago, recent fossil and molecular evidence shows that whales actually descended from herbivores.

Now the question is whether whales evolved from hippo-like animals. While the molecular evidence says yes, so far, at least, the fossil evidence does not.

Such controversies are hot among paleontologists, but seem to have little impact on our lives one way or the other. But interpreting the fossil record is of more than academic importance. Take global climate change. The consensus is that people are making the Earth's atmosphere warmer by producing increasing amounts of the greenhouse gas carbon dioxide, but nobody is really sure what to expect. How much and how fast will the climate change? And what will the impact be?

The answers may lie in the past. The Earth has previously had natural periods of warming, and the fossil record shows how plants and animals were affected by the increased temperatures. "The history of life on this planet has a lot to tell us about our possible future," says Scott Wing, a paleobotanist at the Smithsonian's National Museum of Natural History.

Wing led a team that studied fossils of plants that grew about 55 million years ago, when global temperatures rose rapidly. Air temperatures shot up as much as 18°F in the Arctic and Antarctic, and water temperatures rose as much as 11°F in tropical oceans. A likely cause was a massive release of the greenhouse gas methane from deep-sea sediments, which contain frozen methane deposits that may be released during underwater landslides triggered by earthquakes.

The fossil record shows that during this ancient warming period, plants much like poinsettias and sumac migrated about 1,000 miles north from the Gulf Coast to the Wyoming area. "Palm trees grew in

Montana," says Wing. Other researchers found that animals likewise migrated north as the climate warmed. However, things are very different today. People have fragmented habitats so much that it's unlikely many plants and animals could follow their preferred climates, which means that future global warming could result in extinctions rather than migrations.

We have come a long way since people believed that fossils grew underground, but there are surely plenty of surprises ahead. Science is a process of constant reevaluation and revision in light of new discoveries, and this may be particularly true when it comes to interpreting fossils. "Paleontology is art, science, and imagination," says Richard Stucky of the Denver Museum of Nature & Science.

The same can be said of Leibniz's unicorn, the Feejee Mermaid, and the Centaur of Volos, albeit with an emphasis on art and imagination over science; perhaps that's why these mythological hoaxes have been so effective. And why new ones keep popping up. An April 1, 2006, article in *The Economist* featured a biologist who wanted to turn horses into unicorns and lizards into dragons. His plan? To use computers to predict the accelerated evolution of the real creatures into the mythical ones. Next, he'd simulate and synthesize the mythical animals' DNA, then inject it into the corresponding real creatures' eggs. His name? Paolo Fril, an anagram of April Fool. Like those before it, this mythological hoax sounds almost good enough to be true. Z

—Robin Meadows is a contributing editor of ZooGoer. She wrote about whale worms in the March/April 2005 issue.



Ammonite fossil.



At the Smithsonian's National Zoo, free-ranging golden lion tamarins live outdoors for several months each year. Their behavior is recorded by FONZ volunteers, and Zoo scientists use the data to help conserve tamarins in Brazil.

A Golden Future

BY JOHN BERRY

Looking up, I saw that the top of the ridge, where we hoped to find golden lion tamarins, was still a long way off. I'm in good physical shape, but this climb was turning out to be a serious challenge. The trail was sinuous and nearly vertical, and the profusion of tree roots, wet leaves, clay soil, and holes made for precarious footing. Andreia Martins, the leader of our hike, had predicted that these tamarins would not be hard to find, but noted that our walk might be a bit tougher than yesterday's. "A bit tougher"

was a bit of an understatement!

The previous day, two different family groups of golden lion tamarins (*Leontopithecus rosalia*) almost rained down on us from the tree canopy. Those monkeys came within ten feet of us, and while they were vigilant, they did not seem afraid. I was astonished that I could be closer to a golden lion tamarin in the forests of Brazil than in the Smithsonian National Zoo's Beaver Valley, where a pair or family of free-ranging golden lion tamarins lives outdoors each summer.

Now, however, the monkeys were nowhere to be seen, and we continued to climb higher in search of them. Suddenly, I slipped and almost impaled myself on a spiny palm as I reached my hand out to break my fall. We had been walking nearly straight uphill for about 30 minutes. It was ten o'clock, and we had to get back to Rio before mid-afternoon to get some sightseeing done there before dark. It was getting hotter and more humid, and I wished we had started our search for golden lion tamarins earlier that morning.

Jennifer Mickelberg, a graduate student and research assistant who manages the free-ranging golden lion tamarin exhibit at the National Zoo, was almost at the top of the ridge. She looked back and encouraged us to continue. "Don't worry," she whispered hoarsely, having lost her voice the day before. "Andreia has never led a group here that did not see tamarins. She wouldn't let you leave this forest without seeing them!" A few moments later, she added, "Andreia is going back down the hill to see if she can find the tamarin group. She said we should wait here." We were all enormously grateful for the opportunity to rest.

Andreia is field coordinator for the Golden Lion Tamarin Reintroduction Field Team. Every day, the team scampers up and down the steep slippery forested slopes, facing groves of spiny palms and other dangers including snakes, biting ants, chiggers, and mosquitoes as it searches for zoo-born golden lion tamarins and their descendants. There are now about 700 such tamarins in the wild,

more than 40 percent of the total number of golden lion tamarins in Brazil's Mata Atlântica, or "Atlantic Forest."

The Mata Atlântica is one of the world's most critically endangered "hotspots" for biodiversity. No more than six percent of the original forest remains, but despite its degraded and fragmented state, it harbors globally important biodiversity and many endemic species, including golden lion tamarins, which occur nowhere else on Earth.

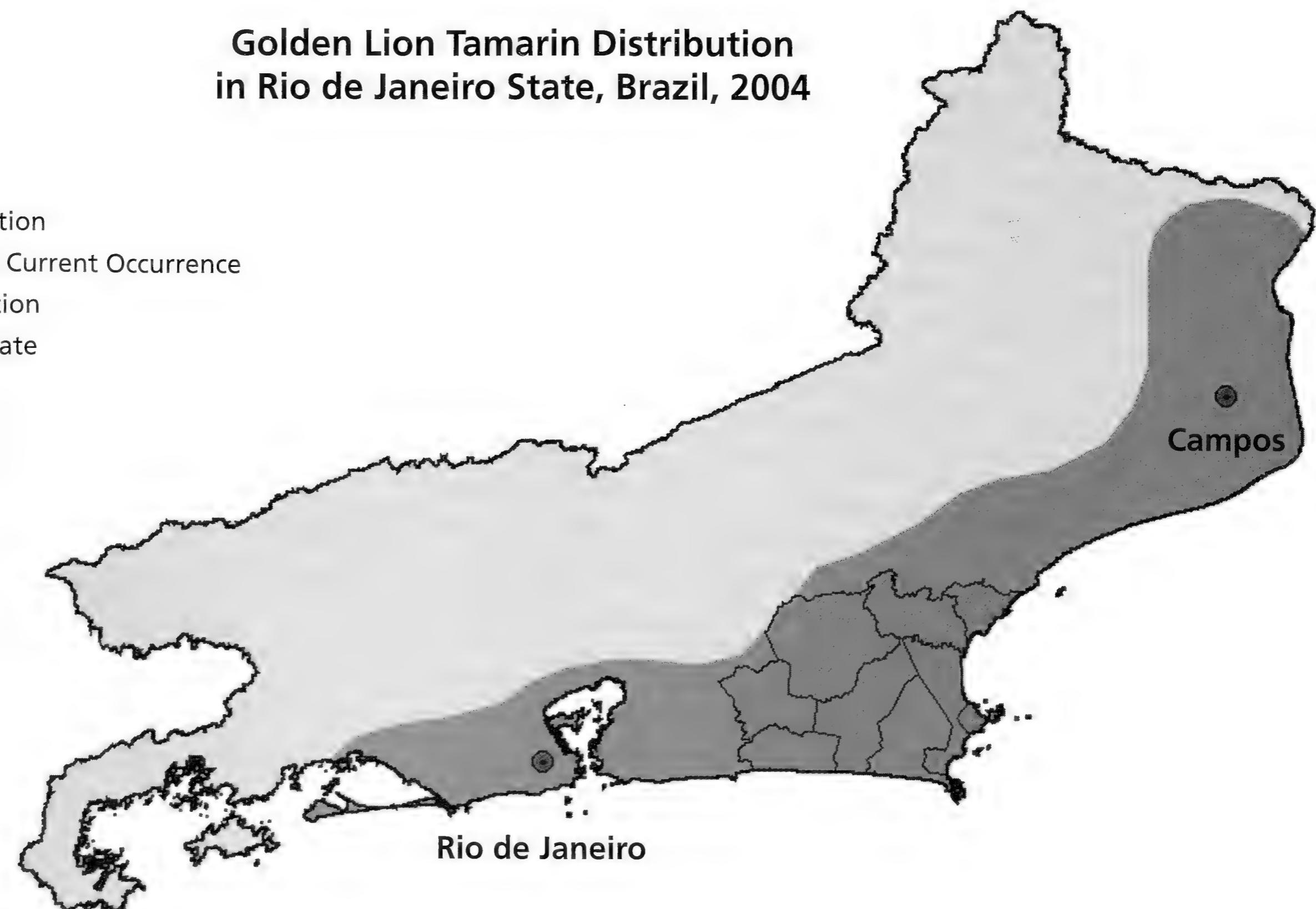
I was in Brazil at the end of May to see the results of the National Zoo's 30-year involvement in the conservation of these endangered monkeys. In the early 1970s, the National Zoo collaborated with two Brazilian nonprofit organizations to create the Golden Lion Tamarin Conservation Program, which has grown into a multidisciplinary, international effort to preserve, protect, and study golden lion tamarins and their forest habitat. The Zoo's participation in the program is a classic example of how it integrates management of zoo populations with conservation in the field.

The program has had a major impact on the survival of the endangered golden lion tamarin; it has also greatly enhanced legal and effective forest protection, and helped to restore and connect remaining forest patches. Using the golden lion tamarin as a flagship species, the program is ensuring the survival of an endangered ecosystem and many threatened species. It may also ensure the survival of species that have never been described by scientists. But there are many obstacles ahead and, I was able to hear about them and the plans to overcome them.

Golden Lion Tamarin Distribution in Rio de Janeiro State, Brazil, 2004

Legend

-  Original Distribution
-  Municipalities of Current Occurrence
-  Current Distribution
-  Rio de Janeiro State





John Beatty/NZP

The author saw this golden lion tamarin in the wild during a long and difficult hike through the Mata Atlântica region of Brazil.

The Golden Lion Tamarin Conservation Program is headquartered in the greater metropolitan region of Rio de Janeiro, Brazil, one of the most densely populated areas in the world. The distance from Rio to the tamarins' Mata Atlântica habitat is similar to the distance from Washington, D.C., to Frederick, Maryland—about 50 miles.

We saw the effects of deforestation as we drove from Rio de Janeiro northeast along Brazil Route 101. Cattle and an invasive African grass covered much of the rolling hilly landscape. Some hillsides were severely eroded, with deep gullies cascading down in abstract patterns, exposing the red clay soil. Patches of forest topped the hills like poorly maintained hairpieces, but there was no forested connection between them.

We also passed ceramics factories fueled by charcoal, which Devra Kleiman said sprung up during the oil crisis of 1973. Devra, the coordinator of the Golden Lion Tamarin Conservation Program from 1972 to 2000, and a former assistant director for research at the National Zoo, accompanied us from Rio to see the tamarins.

Along the way, she explained the history of the Zoo's investment in golden lion tamarin conservation. In the 1960s, while massive deforestation fragmented their habitat in Brazil, hundreds of tamarins were captured for zoos and as pets, and the wildlife trade contributed to the near extinction of the species in Brazil. Many tamarins were sent to U.S. and overseas zoos, but by 1970, few survived, because

reproduction had been poor. A group of zoos organized a workshop, called "Saving the Lion Marmoset" (as the golden lion tamarin was then known), at the National Zoo in 1972 to determine what could be done to improve breeding and also to help the ever-worsening situation in the wild. At the time, some estimates suggested that tamarin numbers were hovering in the hundreds, down from a probable population of hundreds of thousands, or perhaps even millions, before Europeans arrived in the Americas.

After that workshop, the National Zoo decided to commit its staff and resources to conserving this charismatic monkey. Devra began to manage the studbook, a listing of the genetic lineages of the fewer than 70 golden lion tamarins that were distributed in zoos around

the world. More important, she organized a research program in behavior and nutrition to figure out how best to keep and breed golden lion tamarins in zoos. By 1984, the research led to the first successful international reintroduction program for a primate.

I thought about the tamarins' decline as I rested on a tree stump, which thankfully did not harbor a biting ant colony. I saw Devra below, looking rather hot and exhausted as she clambered up the hill. And then I heard tamarin calls coming from behind her, down the hill. All of us bolted upright and were ready to move downhill again, until Jennifer laughed and said that it was only Andreia, who can produce tamarin "long calls" that are indistinguishable from the

Using the golden lion tamarin as a flagship species, the program is ensuring the survival of an endangered ecosystem and many threatened species.



John Berry, left, helps a member of the Golden Lion Tamarin Association plant a tree in an effort to connect isolated patches of golden lion tamarin habitat with forested corridors.

monkeys'. Tamarins live in groups averaging six individuals, and as one group approaches another in the forest, they communicate with long calls composed of whines and clucking sounds. Groups of tamarins respond to Andreia's long calls as if she were an invading group.

The long calling continued, and finally Jennifer said that Andreia had indeed attracted tamarins near the area where we had originally started climbing. We tripped, rolled, and slipped down the steep hill. There, at some distance, was a group of tamarins—just a glimpse of gold that disappeared into the canopy.

Over the last day and a half, I had learned much about what was being done to protect existing tamarin habitat and to create more of it. We were hiking on a private ranch near the Poço das Antas Biological Reserve, which was established by the Brazilian government in 1974 to protect golden lion tamarins. Poço das Antas was the first reserve in Brazil created specifically for an endangered species. In 1997, the president of Brazil, Fernando Enrique Cardoso, established a second reserve with excellent forest, which is now called the União Biological Reserve, from a ranch owned by the national railroad company. Since 1994, researchers had been translocating tamarins they rescued from developing areas into União. From an original six tamarin groups, that translocated population has now increased to more than 200 individuals.

More recently, many local landowners have agreed to devote parts of their properties to official private reserves. This is a dramatic change from a decade ago, when local landowners were downright hostile to golden lion tamarin researchers and conservationists, thinking that big government would expropriate any of their land that contained

forest or tamarins. The change came about when a few landowners agreed to accept reintroduced zoo-born tamarins onto their property, and then became local heroes after receiving positive local publicity and suffering no negative economic consequences.

Education campaigns also focused on generating local pride based on the fact that golden lion tamarins and the Mata Atlântica are unique to this region of Brazil. Today, the Brazilian government provides some tax benefits to landowners who contribute land to private nature reserves (comparable to conservation easements in the U.S.), and the state of Rio de Janeiro has more of these private reserves than any other state in Brazil. Also, groups of reintroduced tamarins live on more than 28 private ranches. Since the Golden Lion Tamarin Program began, the amount of protected land for golden lion tamarins has more than doubled, an amazing feat considering that forest is still illegally being cut on private lands. More than 100 rural properties are now participating directly in the management, restoration, and protection of golden lion tamarins and their habitat.

We spent one night at one of the private reserves holding golden lion tamarins, Fazenda Bom Retiro. The ranch is owned by Luis Nelson, who is trying to transform it from a typical cattle ranch into a destination for ecotourists. The cabins are sited at the base of a hill and the ranch's gardens, waterfalls, and birdlife made the spot one of the most beautiful I saw during my visit to Brazil. Dozens of hummingbirds flitted in and out to drink from the well-distributed feeders.

Expanding and connecting existing forest in the region is currently the highest priority for golden lion tamarin conservationists. Denise

Rambaldi, CEO of the Brazilian nonprofit Associação Mico Leão Dourado (AMLD), or Golden Lion Tamarin Association, showed us how the AMLD contributes to conserving golden lion tamarins, and to improving the economic situation of very poor local subsistence farmers. Denise is a dynamic conservationist: She led the campaign to create União, and worked with landowners and the government to develop and expand the private-reserve process. She also joined forces with multiple municipalities and additional partners to establish a special ecological area with zoning restrictions in the local watershed. Now, the entire watershed of the São João River—nearly 500 square miles encompassing all remaining habitat for golden lion tamarins—has been declared an Environmental Protection Area, a federal conservation unit guaranteeing integrated land-use planning for the entire region.

Denise took us to visit a tree nursery, run by a peasant cooperative, that the AMLD was instrumental in developing. Since 1994, people without their own land have been settling in the region. Some were sent by the government as part of its agrarian reform program, while others encamped illegally on the land as members of the Landless Rural Workers' Movement (MST). The MST is a nationwide, grassroots political movement composed of poor, landless Brazilians seeking to redistribute the arable land in Brazil.

Denise and the AMLD trained these settlers in agroforestry techniques and found money to establish the nursery to give them an alternative source of income, so they would not cut the remaining forest, hunt on the nearby reserves, or extract other resources from them. What began as a conflict between the MST and those committed to biodiversity protection has become a reciprocal partnership, and the settlers are now supporters of and contributors to environmental restoration.

The nursery grows only tropical-forest tree species from the Mata Atlântica, to be planted in corridors between forest fragments that harbor golden lion tamarins. Denise told us that the AMLD not only plants trees between small local forest fragments on neighboring ranches, but is also developing a 12-mile corridor between two very large forest fragments: Poço das Antas and a ranch with nearly 250 reintroduced tamarins called Rio Vermelho. We purchased some trees and planted them just before returning to Rio the next day. Among them were two specimens of the very rare *pau brasil*. This hardwood is the national tree of Brazil and was one of the first species to be logged from the Mata Atlântica.

Denise talked to us about the future challenges and goals for golden lion tamarin conservation. The current target is to reach 2,000 individual golden lion tamarins living freely in a landscape of about 95 square miles of connected and protected Mata Atlântica habitat by 2025. While the number of tamarins is currently near 1,500, the amount of

Jessie Cohen/NZP



A golden lion tamarin at the Zoo's Small Mammal House.

protected and connected forest is still less than half the goal, which is why building forest corridors is such a high priority.

The Golden Lion Tamarin Conservation Program is recognized globally as the premier model for an integrated reintroduction and conservation program for a Neotropical primate. Within the Mata Atlântica, the golden lion tamarin is the flagship species for the conservation of the region and has instilled pride among local people in their natural resources and unique regional biodiversity. The golden lion tamarin is also known and admired nationally. Brazilian people voted to make it a symbol on one of the newest Brazilian banknotes, the \$20 *real*, and the national post office has issued a commemorative stamp and postcards featuring golden lion tamarins.

When the program began, there were no recipes for organizing and running a reintroduction program successfully; basically, participants in the Golden Lion Tamarin Conservation Program had to write the cook book. Mistakes were made and methods changed, using an adaptive management approach. Andreia and Ben Beck, the American reintroduction coordinator (and formerly an associate director for animal programs at the National Zoo), found that to maximize survival and reproduction, reintroduced tamarins require post-release provisioning, careful management (they must be caught and taken home if they get lost), and veterinary support. Not surprisingly, zoo-born tamarins do not instinctively know

A Brazilian banknote featuring a golden lion tamarin.





The Golden Lion Tamarin Conservation Program reintroduced more than 150 golden lion tamarins to the wild between 1984 and 2000 with great success. The self-sustaining population in the Mata Atlântica has grown so much that the species is no longer considered critically endangered.

how to forage, feed, and navigate in tropical forest. As released zoo-born tamarins learn these skills, the reintroduction team gradually discontinues food provisioning, and eventually the tamarins become fully independent.

The reintroduction team also determined that it is always best to release golden lion tamarins in family groups rather than singly or in pairs, because tamarins are monogamous and live in small nuclear families. Eventually, the youngest animals do the best and become the next generation's breeders. Amazingly, the wild-born offspring of zoo-born animals learn on their own how to forage, feed, navigate, and survive in the wild, and may even teach their parents some of these skills. Between 1984 and 2000, when the last release occurred, the Golden Lion Tamarin Conservation Program reintroduced 147 zoo-born and 12 confiscated wild-born animals. Today, there are about 700 golden lion tamarins derived from the reintroductions and nearly 250 from the translocations to União Biological Reserve. The program has been so successful that the golden lion tamarin was reclassified in 2003 by the World Conservation Union (IUCN) from critically endangered to endangered.

The future challenge is to connect the isolated populations so there will be genetic interchange leading to a single large, genetically diverse population. As it stands now, there is a strong possibility that inbreeding will have a negative effect on golden lion tamarin survival because, despite the growth rate of both the reintroduced and translocated populations, each of the existing populations is too small and isolated for long-term viability. A major catastrophe such as a fire could wipe out one of these populations.

Scientists are currently planning a meeting to evaluate the

potential for inbreeding problems and to make recommendations for managing the entire fragmented population. The meeting will follow a complete census of the existing tamarin population and a genetic analysis to assess what genetic differences exist among the isolated groups. That may lead to a recommendation for additional reintroductions, if the current zoo population has genes not present in the wild. For now, however, future efforts are devoted to increasing the extent of forest in the region, especially by increasing connections between the remaining isolated populations. Until there are corridors linking the isolated populations in a large landscape, reintroduction and translocation will remain the key tools for the management of the species.

As we drove back to Rio de Janeiro, I realized that the goal of 2,000 golden lion tamarins in a connected forested landscape of about 95 square miles is ambitious. Numerous problems, questions, and challenges remain. But I also realized the team in place in Brazil can surmount these problems, with continued support.

Soon after returning from Brazil, I watched the release of a tamarin family into its semi-wild habitat in the Zoo's Beaver Valley, where free-ranging tamarins live each summer. Who knows? This group might eventually find itself in Brazil, as so many zoo tamarins have before. *Z*

—John Berry is the Director of the Smithsonian's National Zoo.

If you would like to contribute to the Golden Lion Tamarin Conservation Program, please visit www.fonz.org/helpglts.htm.

Books, Naturally ■■■

Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder

Richard Louv. 2006. Algonquin Books of Chapel Hill, Chapel Hill. 334 pp., softbound. \$13.95.

After the tales my daughter, Lesley, told about her first overnight summer camp experience, I called it the “lord of the flies camp.” A bunch of 12-year-olds spent a week in the mountains, living in ramshackle cabins, exploring the woods, playing games, and even preparing most of their meals, all with very little adult supervision—and then only if you think of 18-year-olds as adults. Despite this, we sent her back for two weeks the next summer.

This time, the kids hiked and camped out for several days, led by two teenage “adults.” On that trip, they ran out of water and were reduced to eating dry pasta. A black bear ambled into their camp one night, knocked over the tent my daughter was sharing, and made mischief with their gear, leading to terror all around and six girls shivering in the remaining tent. “We barely survived,” Lesley reported, but 12 years later, she is still telling the tales. What was so special to her was not just being in the woods—we’d taken her camping many times—but being there unfettered by grown-ups.

These kinds of childhood experiences have mostly disappeared in the United States. People of the baby-boomer generation had them, but our children did not. And ours weren’t short, rare adventures. We were always outdoors—exploring the woods, splashing in the creek, or just playing in the street—and checking in with mom only for meals. Lesley was never so free—she was in sixth grade when I realized with a shock that she’d never crossed a street without an adult, much less explored Rock Creek Park, just a few blocks from our home, on her own.

In *Last Child in the Woods*, Richard Louv documents this enormous change in children’s experience in nature. “In the space of a century, the American experience of nature has gone from direct utilitarianism to romantic attach-

ment to electronic detachment...the one that young people are growing up in today. ...” And there is a growing body of evidence and expert opinion that “electronic detachment” is deleterious to physical and mental health, resulting in “nature-deficit disorder.”

How did we reach this state? As Louv reports, there are now fewer parks, vacant lots, and patches of woods for unstructured play, but many more fields for organized sports. The threat of litigation keeps all but the safest play spaces off limits. Fear of crime, abductions, and traffic makes parents overprotective, while air conditioning, television, and computers make staying indoors attractive. Louv quotes a fourth-grader who said, “I like to play indoors better, ’cause that’s where all the electrical outlets are.” And then there’s time, which none of us has enough of anymore. But, “It takes time, loose, unstructured time, to experience nature in a meaningful way.”

Among other effects, Louv links nature-deficit disorder to childhood obesity, depression, and attention deficit hyperactivity disorder (ADHD). The evidence for these is still thin and often anecdotal, but the hypotheses are intriguing. One carefully controlled study found that children with ADHD were far better able to concentrate after outdoor activities, especially those among trees and grass. Even being able to look out a window at green space reduced ADHD symptoms!

Other studies show that exposure to nature tends to make children more resilient against stress, and that adult surgical patients recover

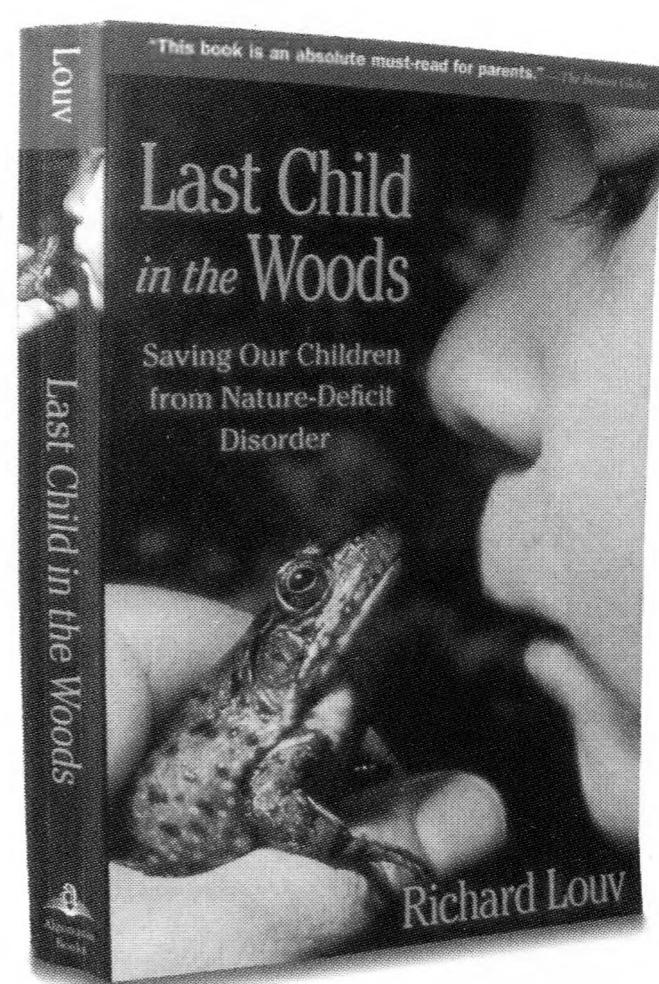
more quickly in rooms with views of trees than those with views of a wall. Exposure to nature also seems to stimulate creativity, while old-fashioned outdoor activities, like building forts and tree houses, made the outdoors a natural classroom where kids learned engineering principles through trial and error.

Schools offer few or no hands-on experiences of nature either. At the same time, kids do learn about environmental disasters, such as the destruction of tropical rainforests, with perhaps counter-productive effect. Writes Louv, “Lacking direct experience with nature, children begin to associate it with fear and apocalypse, not joy and wonder.” The focus on remote areas gives kids the impression that nature is something far away, not where they live. When we urgently need a new generation

of activists to champion nature conservation, how will these children, Louv asks, ever grow up to care about saving the natural world in their own communities or anywhere else? Communities across the country must recognize that children, and adults too, need nature to thrive, and figure out how to provide it as a service essential to our well-being.

I highly recommend *Last Child*, both to parents and to wired twentysomethings who might benefit from a good dose of the nature they missed. Lesley recently returned to D.C. from a five-year stint in New York City. We were stunned when our city-lover decided to go camping with a friend. After reading this book, I think I know why.

—Susan Lumpkin

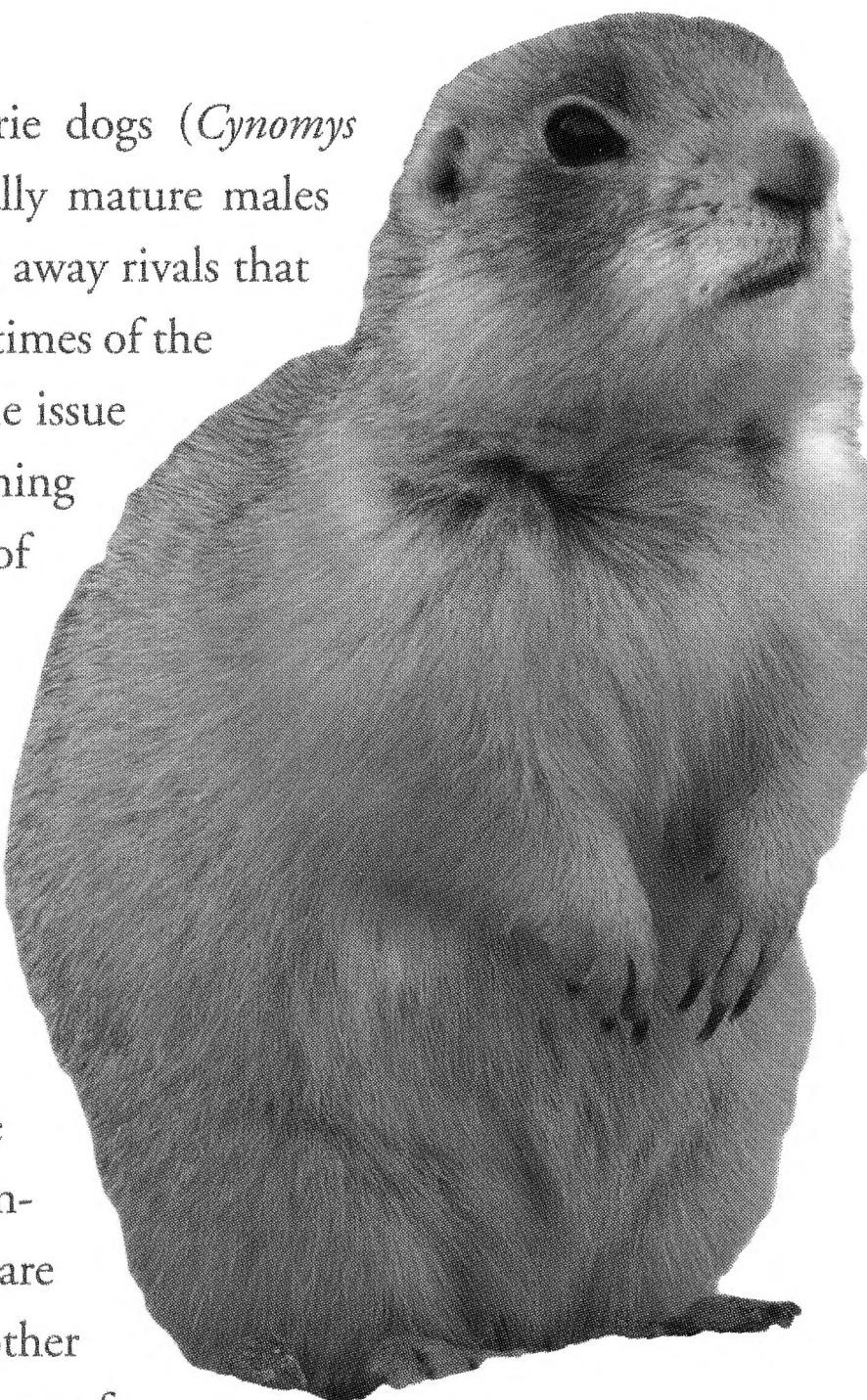


BioAlmanac

by Shannon Lyons

Dying for a Mate

Courting can be deadly for male Utah prairie dogs (*Cynomys parvidens*). During their mating season, sexually mature males are so engrossed in finding females and chasing away rivals that they are less vigilant for predators than at other times of the year, according to a study in the October online issue of *The American Naturalist*. For 124 days beginning in March 2005, scientists observed a colony of Utah prairie dogs in Bryce Canyon National Park. They were surprised to find that northern goshawks (*Accipiter gentilis*) and red foxes (*Vulpes vulpes*) killed a total of ten sexually mature male prairie dogs during the 17-day mating period in April, but none during the other 107 days of observation. The study also shows that old and weak prairie dogs are less likely to be caught than their healthy counterparts. The most vulnerable to predation are pregnant females, juveniles, immigrants from other colonies, and individuals living on the periphery of the colony rather than at its center.



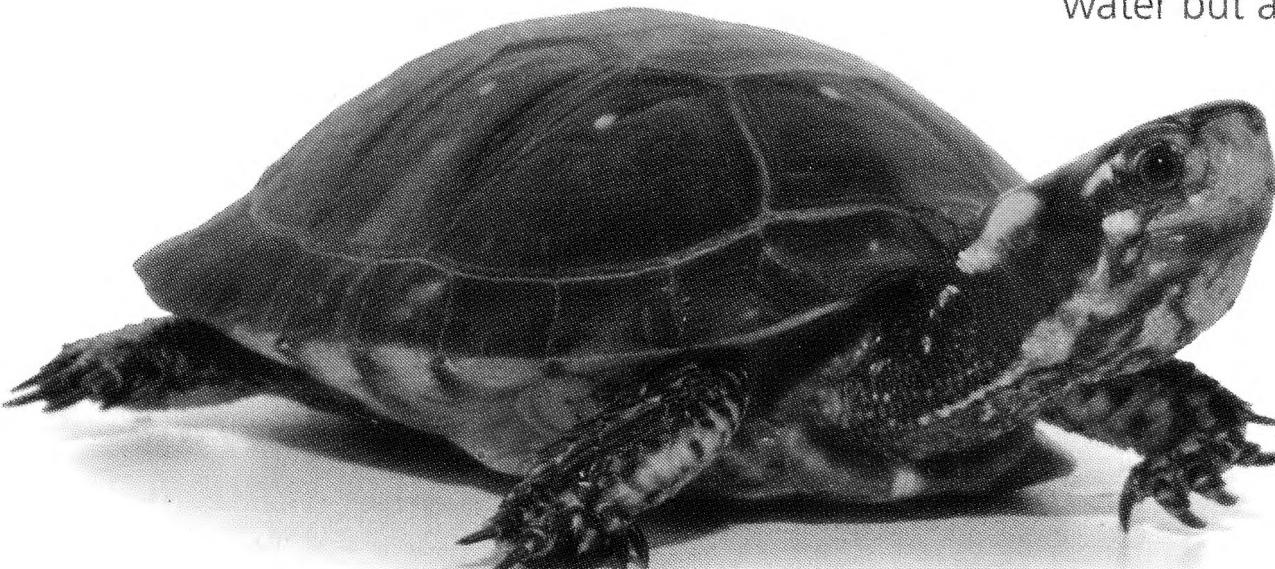
What's in a Name?

All turtles, tortoises, and terrapins have toothless "beaks" and shells made of bony scutes. But how are they different? Taxonomically, the designations are simple: All reptiles in the order Chelonia are turtles. Within Chelonia, only three species are properly called terrapins, and only members of the family Testudininae are true tortoises. But colloquially, the usage varies from place to place. Americans commonly call terrestrial chelonians like the desert tortoise (*Gopherus agassizii*) "tortoises," aquatic or semi-aquatic chelonians like the spotted turtle

(*Clemmys guttata*) "turtles," and chelonians living in or near brackish water like the diamondback terrapin (*Malaclemys terrapin*) "terrapins." Australians often use the term "tortoise" for all but sea turtles, and Britons tend to refer to saltwater species as "turtles" and freshwater species as "terrapins."

Turtles live on every continent except Antarctica, and their names are just as widespread. The Dry Tortugas islands near Florida are so named because explorer Ponce de Leon visited them in 1513 and found no fresh water but an abundance of sea turtles, or *tortugas* in Spanish.

The University of Maryland's mascot is a diamondback terrapin whose name, *Testudo*, is the Latin word for turtle. And turtles achieved widespread sartorial fame with the advent of the turtleneck.



The plant *Rafflesia arnoldii* of Sumatra and Borneo has the world's largest individual bloom, which can be up to three feet in diameter and weigh more than 24 pounds.

Why Are Some Cats Black?

Although they were once reviled as evil omens, black housecats rarely generate much attention these days. But black cheetahs, lions, and bobcats tend to cause a stir. That's because melanism, a genetic phenomenon that causes a high concentration of the dark pigment melanin in animals' fur, skin, or feathers, is fairly common in some cat species but highly unusual in others. Melanistic cats' dark background fur obscures their spots, stripes, or other typical markings. Studies show that melanistic servals, jaguarundis, and leopards (also called "black panthers") are much more prevalent in rainforests and other humid habitats than in dry habitats. Melanism might be an adaptation that camouflages these cats as they hunt along dimly lit forest floors, and it has also been linked to increased resistance to disease.

Fact or Fiction: Toads Give People Warts

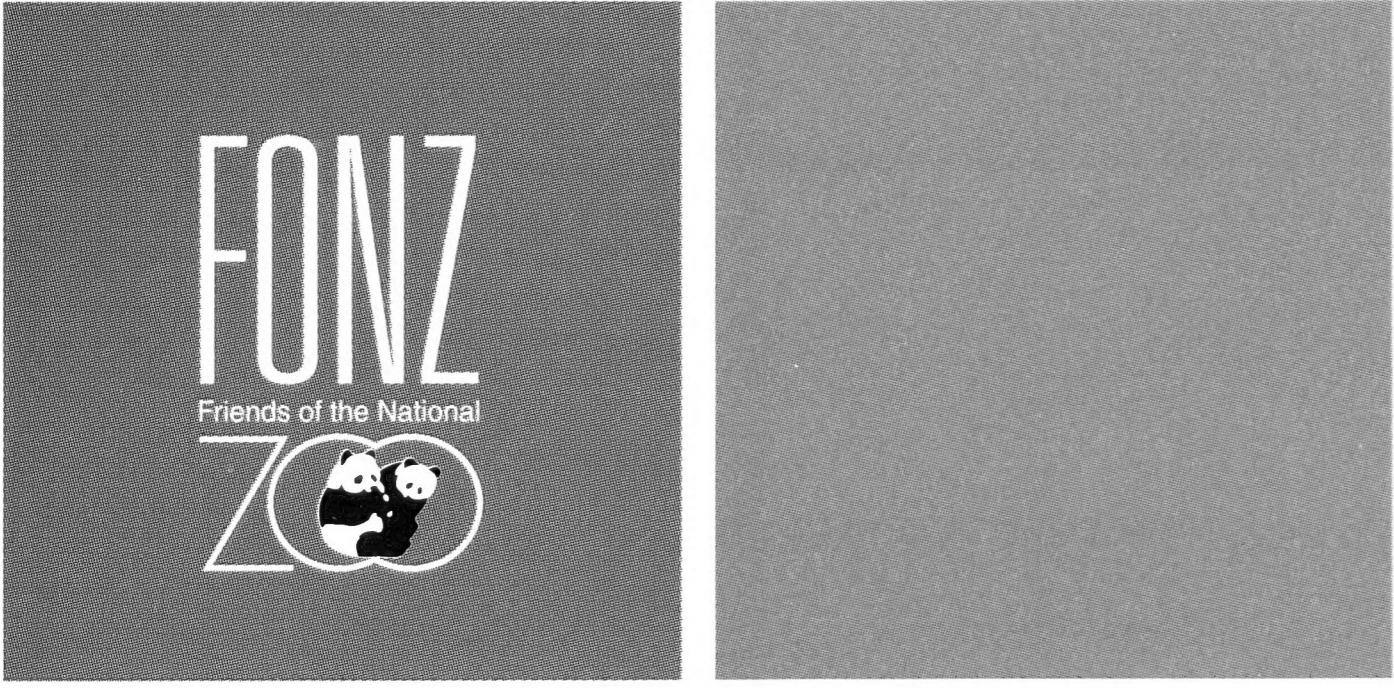
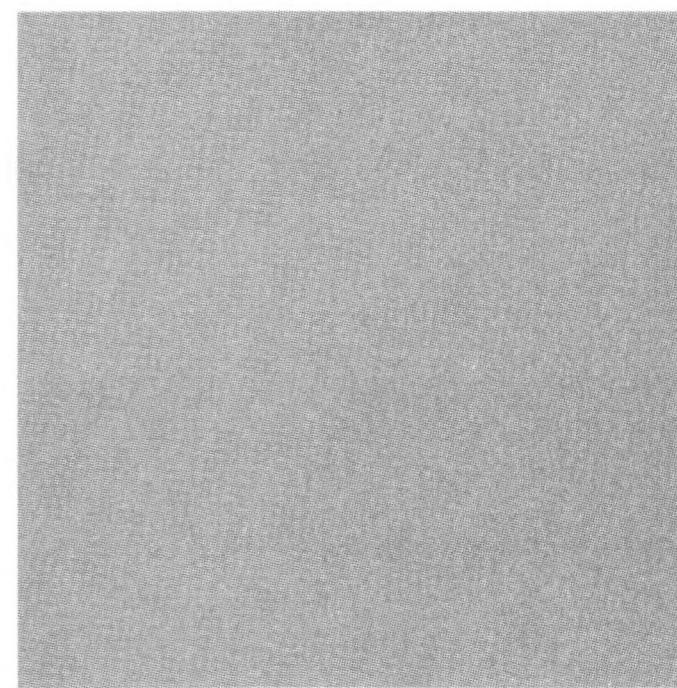
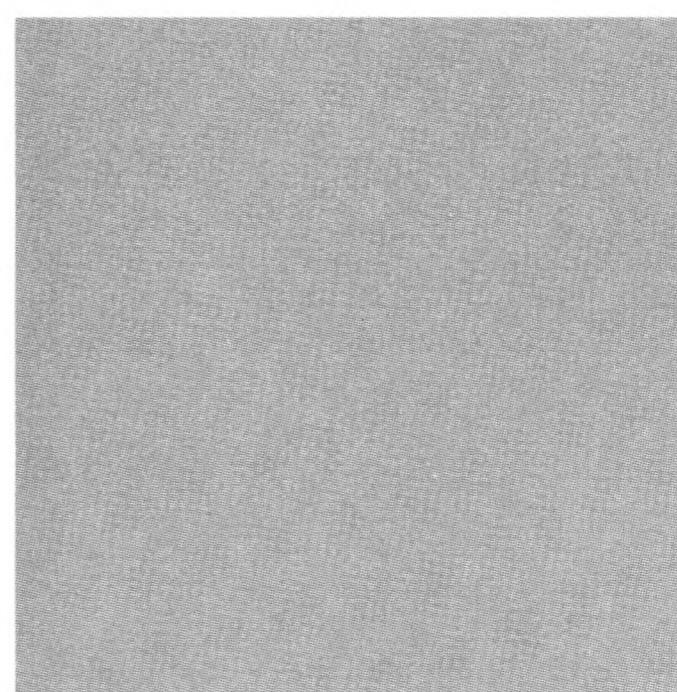
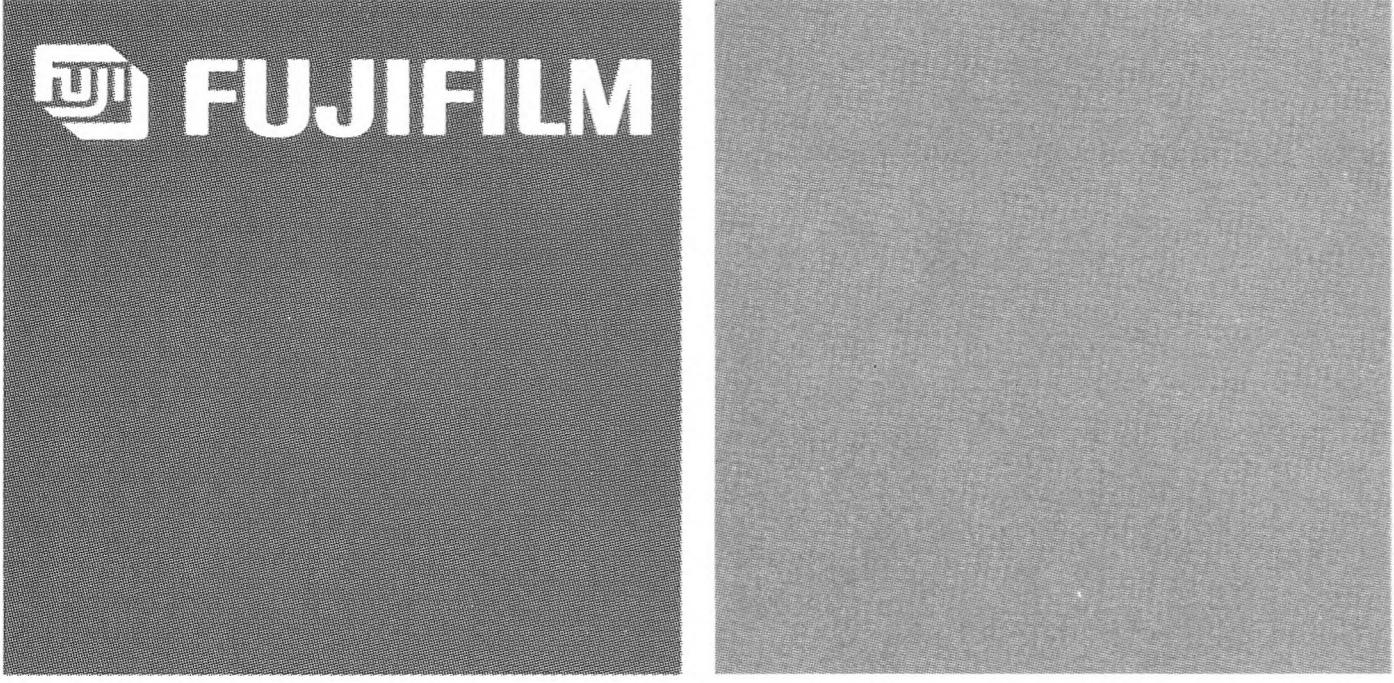
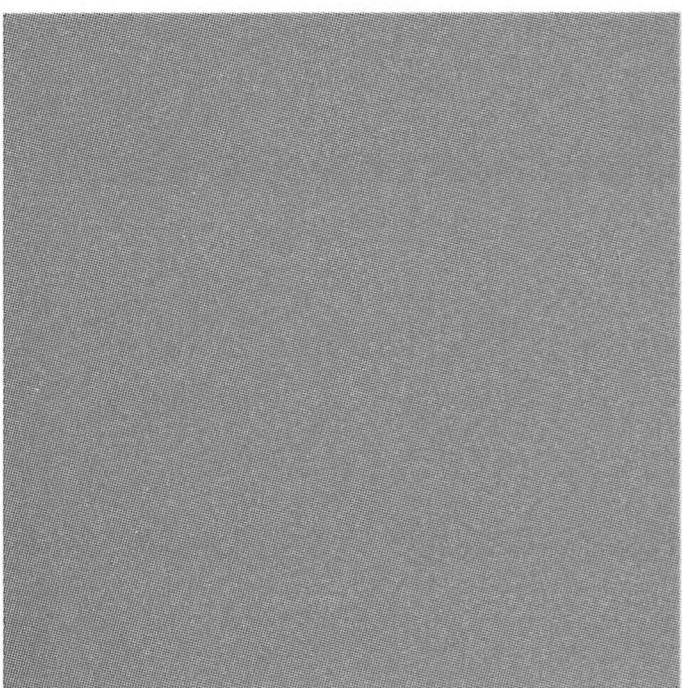
Toads do not contract or carry the virus that causes human warts, so their bumps are not contagious. But they're not always harmless, either. When some toads, especially those in the genus *Bufo*, are threatened, their bumps secrete poisons called bufo-toxins. Humans who handle these amphibians typically suffer minor skin or eye irritation, but a dog that bites one may experience severe nausea, paralysis, seizures, and even death. People have known about toad toxins for centuries, and they play a role in Shakespeare's *Macbeth*. As the Weird Sisters gather around a cauldron to concoct a potion, the First Witch intones, "Toad, that under cold stone, Days and nights has thirty-one; Swelter'd venom sleeping got, Boil thou first i' the charmed pot!"



In Season

In North America in late autumn and early winter, juvenile raccoons, bears, coyotes, foxes, weasels, and otters disperse from their natal homes to find their own territories and mates. They depart before the late-winter mating season begins, freeing their mothers to conceive a new set of offspring that will be born in the spring.

Prairie dog: Bruce Coleman Inc./Edward L. Snow. Spotted turtle: Jessie Cohen/NZP. Woodhouse's toad (*Bufo woodhousii*): Gary M. Stoltz/USFWS.



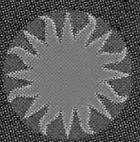
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Visit and enjoy giant pandas Mei Xiang, Tian Tian and Tai Shan at the Fujifilm Giant Panda Habitat as well as six other Asian species along Asia Trail.

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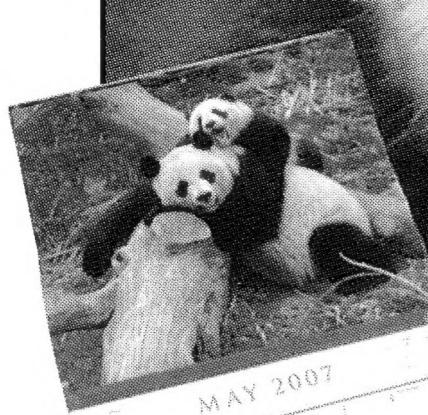


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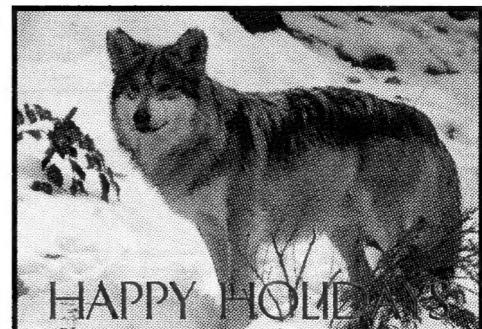
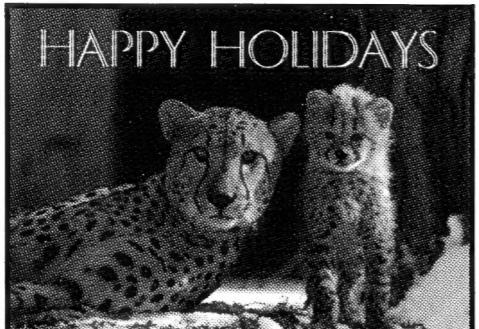
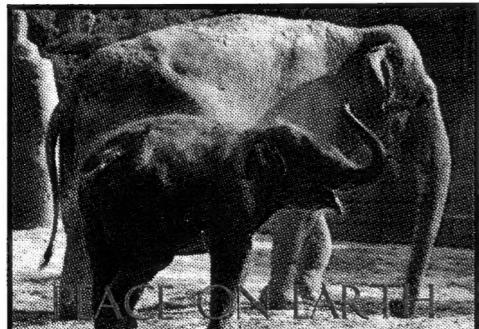


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